ISOMETRIC

Direct Ocean Capture and Storage 1.0 Protocol

Public Consultation Summary

Published on October 1, 2025

Context

Isometric held a public consultation on its Direct Ocean Capture and Storage 1.0 Protocol to receive stakeholder input on this Protocol.

The public consultation was announced on the 27th of May, 2025. The period of consultation lasted 30 days, with the final day as the 27th of June, 2025.

After the initial public consultation, the feedback received was considered for incorporation into the Direct Ocean Capture and Storage 1.0 Protocol. All stakeholders have received responses to the submitted feedback.

This document summarizes the feedback received during the public consultation and the revisions included as a result of the comments. Content in italics and brackets are excerpts from the public consultation version of the protocol to give the reader necessary context behind the comment.

We thank all participants for their time.

Summary of feedback received

Direct Ocean Capture and Storage 1.0 Protocol			
Theme	Resolution	Comment	Section
How do future changes in financial additionality intersect with the additionality review outlined in the Isometric Standard?	This text has been revised to be consistent with the frequency of additionality review required by the Isometric Standard v1.7.6. The new text is: "Additionality determinations must be reviewed and completed at initial project validation, every subsequent revalidation, and whenever operations change significantly (i.e., may impact materiality)..." Projects may also be considered re-eligible if conditions, such as feedstock costs, change significantly.	What if conditions revert to being financially additional, due to e.g. fluctuations in feedstock costs - could a project be made re-eligible?	Additionality
Clarity needed on some specifics of the applicability requirements	The quantification approach which includes modeling to upscale the DIC-deficient plume and air-sea CO_2 uptake is currently specific for fixed point discharge. Thus, moving deployments would not be applicable. This is not due to concerns of efficacy. Should there be sufficient interest in quantification for moving deployments, the Protocol and air-sea CO_2 uptake Module could be expanded in scope accordingly.	Is the reason for exclusion of moving deployments due to questions on efficacy, or current ease of modeling/monitoring ?	Applicability
	The surface ocean is defined as: the ocean mixed layer, whose depth can vary depending on time and location. The Protocol has been updated to link to this definition.	how do you define surface ocean?	Applicability

How does Carbonate Compensation depth relate to dilution capacity?	In this context, the dilution capacity is a physical metric based on the relative volume of the receiving water body compared to the discharge. The Carbonate Compensation Depth is not expected to affect the dilution capacity.	How will the Carbonate Compensation Depth at a place affect the dilution capacity at a place?	Background Concepts
Correct delineation of counterfactual CO_2 storage	Thank you for pointing this out. It is correct that DOCS results in net increase in CO_2 storage at the durable storage reservoir (e.g. geologic storage), DOCS projects increase air-sea CO_2 uptake by the ocean. While durable storage of CO_2 extracted from seawater is a necessary component of the DOCS process, this Protocol quantifies gross carbon removal based on the additonal air-sea CO_2 uptake and CO_2 losses, rather than increase of CO_2 in a durable storage reservoir (e.g. geologic storage). The Protocol text has been updated to "positive values indicating a net increase in air-sea CO_2 flux over the counterfactual scenario".	I don't think there should be a net increase in marine CO_2 storage for DOCS, it would either be no net change or a slight decrease. The increase in CO_2 storage is wherever the CO_2 stream is stored.	Calculation of CO_2eCounterfactual
Clarifications on CO_2eEnd-of-Life calculation	At this stage, it is expected that allocation of emissions for shared storage infrastructure will be conducted on a carbon concentration x mass flow basis. However, alternative agreements that have been contractually negotiated between the Project Proponent and storage partner, may be accepted on a case by case basis. At minimum, all emissions from shared infrastructure must be accounted for.	How is this defined/calculated?	Calculation of CO_2eEnd-of-Life
	The Reversal process is in place to prevent the risk of strategic defaults. Ultimately, any emissions debt from a project at its end of life must be compensated, either through allocation to another project or through the Reversal process.	Too week... Such wording leaves to door open for strategic defaults... Please check and address.	Calculation of CO_2eEnd-of-Life
	We have retained the wording "when" as it is referring to the planning stage, which is prior to ceasing operations.	replace: "When" with "Before"	Calculation of CO_2eEnd-of-Life
	The Isometric Standard outlines the principles by which the Isometric Crediting Program adheres to. Transparency includes the full traceability of Carbon Fluxes involved in the quantification of Removals. Reversals are	augment: "triggered, documented and communicated"	Calculation of CO_2eEnd-of-Life

	included within the quantification of Removals and are held to the same standards for reporting and communication.		
Which processes apply to storage of CO_2, and characterization of feedstocks?	CO_2 storage in depleted hydrocarbon reservoirs has been added.	What about depleted oil & gas reservoirs that are converted to CO_2 storage?	Calculation of CO_2eFugitive Emissions
	Currently only rock and mineral based alkaline feedstocks are eligible for use in CO_2 Storage via Ex-Situ Mineralization in Closed Engineered Systems and CO_2 Storage via Carbonation in the Built Environment storage modules.	Please specify that these mineralization processes should not derive the alkalinity from seawater	Calculation of CO_2eFugitive Emissions
Spelling, grammar and phrasing corrections	Addressed.	typo	Calculation of CO_2eRemoval
	Addressed.	typo	Calculation of CO_2eRemoval
	This has been fixed	wrong acronym	Facilities with Co-Products
	This sentence has been adjusted for clarity. "Various methods can be used for Direct Ocean Capture, such as chemical (including electrochemical and photochemical) separation of dissolved inorganic carbon from seawater."	I find this sentence confusing or incomplete?	Introduction
	Change accepted.	must?	Measurement and Monitoring Requirements
	Corrected	s' missing	Overarching Principles
	Change accepted.	It's sort of implied by the third bullet, but can you explicitly include the methods for environmental monitoring measurements too?	Project Design Document
	Changed to: "model outputs and analysis code must be shared so that the results are reproducible."	I believe you say "must" before, somwhere at the top	Reporting
	Change accepted.	GHG statement? The model runs may not have been completed at the start of the project, when the PDD is submitted	Reporting

	Change accepted.	DIC must (not "may") be measured to validate the mass of CO_2 removed per 8.2.1.1.1	Seawater influent and effluent
	Changed to must.	Why should? Why not must?	Step 1: Measurements of Seawater Carbon Capture
	For consistency with other Protocols and Modules, this text has been left unchanged.	replace "may" with " a relevant cross-section of independent"	Stakeholder Engagement
	For consistency with other Protocols and Modules, this text has been left unchanged.	replace: "may" by "should be actively and regularly engaged to"	Stakeholder Engagement
	Unchanged. When possible, direct observation is preferred at all site visits, irrespective of scaling.	delete ",whenever possible," and replace by, ", for those sites that undergo rapid and material scaling,"	Site Visits
	Fixed.	typo	Step 2: Upscaling of DIC-depleted plume
	Language has been adjusted to "limiting the increase in pH"	Limiting the increase in pH? Clarify that you don't mean a lower bound on pH	Step 2: Upscaling of DIC-depleted plume
	Corrected.	I think either "and" or "with" make sense	Step 2: Upscaling of DIC-depleted plume
	Yes, language has been updated.	and approved by Isometric and VVB?	Step 2: Upscaling of DIC-depleted plume
	Change accepted.	validation	Storage of CO_2 removed from seawater
	Fixed.	wrong acronym	System Boundary & GHG Emissions Scope
	Fixed.	wrong acronym	System Boundary & GHG Emissions Scope
	Fixed.	wrong acronym	System Boundary & GHG Emissions Scope
Improved definition of CO_2eRemoval	Your interpretation is correct, the text has been updated for clarity to the following: "It should be noted that any potential loss	If I understand this correctly, you are saying that this is	Calculation of CO_2eRemoval

term	of extracted CO_2 from the durable storage reservoir which occur after Credits have been issued is considered a reversal".	just not included in the equation; but reversed storage is discussed later on and can even lead to elimination of the credits. Should it just be clarified here that reversal of storage (1) credits is accounted for later on, or are you saying two different things?	
	The following terms have been redefined as they represent the storage resulting from all processes within the system boundary. CO_2eStored,RP the total CO_2 removed from the atmosphere and durably stored over the RP, in tonnes of CO_2e. CO_2eCounterfactual,RP the total counterfactual CO_2 removed from the atmosphere and durably stored in the absence of The Project over the RP, in tonnes of CO_2e.	It might help to clarify in the name of this variable that you refer to ocean storage, not geological CO_2 storage (though I know you define it)	Calculation of CO_2eRemoval
What is encompassed in CO_2 stream measurements?	Thank you for the comment. Indeed, there may be long transport distances between capture of extracted CO_2 from seawater and storage in a durable reservoir. The CO_2 transport may also encompass multiple segments (such as various modes of transportation e.g. shipping, pipeline etc., and the use of shared infrastructure). Project Proponents must delineate a complete chain of custody between transport segments to storage in a durable reservoir. Direct metering of CO_2 at the inflow and outflow of each transport segment is required to accurately account for losses which may occur during CO_2 transport.	This could be very close to the DOC facility and very far from ultimate storage	CO_2 stream measurements
	These measurements are for closed-system flow measurements. For CO_2 leakage which may affect nearby water quality, please refer to the monitoring requirements in the respective storage modules.	In addition to flow measurements, till how much of a minimum distance downstream do we check for any contamination or any other harmful change to water chemistry?	CO_2 stream measurements

OAE vs DOCS Protocol consistency	Thank you for the comment. We strive to maintain consistency between protocols such as OAE and DOCS. As protocols evolve over time, there may be instances where a recent release of one protocol has updated requirements compared to a past release of another protocol. These requirements would be standardized at the next update for OAE. We intend to align with the OAE Data Standards Protocol to determine data that is generally relevant for the scientific research. Beyond that, data can be requested by scientific organizations to support their specific research inquiries.	I applaud this, but have two questions: 1. When will you update this in the OAE procotol, where it currently says "should," which you explicitly state up top is different from "must". What prompted you to make this change for DOCS but not OAE? 2. It is not clearly or easily understandable from the protocol what data you consider "relevant to scientific research." How do you define this, and who/how will you enforce it?	Data Reporting and Availability
	Indeed, this language is specific to release of CO_2 that was extracted from seawater and stored in a durable reservoir. Language has been adjusted to clarify this point: "For example, if a project removes 10t CO_2 from the ocean and stores it in a geological reservoir (1), and after air-sea equilibration the ocean (2) absorbs 9t CO_2, then Credits would be issued based on the 9t CO_2 removed from the atmosphere. However if the 10t that was removed from the ocean and stored in geological reservoir (1) ends up being released to the atmosphere after a few years, the net effect of the Project is a 1t emission of CO_2 (10t emitted and 9t removed through air-sea equilibration). " Physical leakage of CO_2 from the durable storage reservoir is absolutely considered and counted through the reversal mechanism. Ongoing monitoring of the storage reservoir is required and details are available in the respective storage module.	I find it interesting that you address this risk here and not in OAE? Wouldn't the risk be the same? Or are you referring to the risk of release from Storage 1 reservoir? In that case I would make it more clear. This relates to my other comment about clarity of how leakage from storage 1 reservoir is accounted for. I generally think it is not sufficient to say leakage after crediting cannot be considered, as this is an invitation for DOCS companies to defer responsibility to the "storage site	Durability and Reversal Risks

		manager" and not worry about it any further.	
Further justification of environmental safeguards requirements	Direct Ocean Capture (DOC) offers an opportunity to restore local ocean chemistry and combat acidification, thereby actively helping vulnerable aquatic life. The key risk in a beneficial change is the potential for unforeseen ecological cascades, particularly when deployed at large-scale. To mitigate this, localized monitoring of biodiversity and nutrient levels can ensure that changes in carbonate chemistry translate into stable, healthy, and diverse marine ecosystems.	Why is helping aquatic life a risk?	Environmental Safeguards
	Thank you for the suggestion. The appropriate environmental safeguards will be site- and project-specific. Please see Section 14.4 for Ocean Monitoring examples. We will continue to add examples to illustrate how these safeguards can be applied in practice as the mCDR industry develops and more literature is published on this topic.	The below list provides a broad and non specific set of criteria. It would be great if you could add some examples. For example, you can compare two hypothetical projects and discuss how the safeguards for one projects are different than the others.	Environmental Safeguards
	Thank you for the comment. Per Section 6.3 of the Protocol and Section 3.7 of the Isometric Standard, Project Proponents are required to identify potential risks, followed by the development of tailored mitigation plans. These plans must encompass specific actions to avoid, minimize or rectify identified impacts. Effective implementation of these measures must also be accompanied by a robust monitoring plan to detect negative impacts and stop projects when necessary. Following the Isometric Standard, Credits issued under this Protocol are contingent on the implementation, transparent reporting and independent verification of comprehensive safeguards.	Practically, too week to stand the test of time. Projects must demonstrate that they undertake reasonable efforts to minimize impacts on key ocean boundaries, notably .... (add relevant kpis that affect marine life and health, with derivative effects on populationsm, their fishing and ocean use nearby).	Environmental Safeguards
		Insufficiently clear language - should improve to make clear statements. Advice: Make assessments	Environmental Safeguards

		commpusory, to mitigate such risks, and ask to log such such assessment diaries, for consistency and fail-safe application without work-arounds.	
	For consistency with other Protocols and Modules, this text has been left unchanged.	augment: "must consider and minimize the following potential risks"	Environmental Safeguards
	For consistency with other Protocols and Modules, this text has been left unchanged.	augment: "handling, containment, disposal and permanent documentation"	Environmental Safeguards
Is it possible to be more specific about when Protocols may be updated in light of scientific literature and/or other advances in understanding?	Changes in scientific literature which may warrant updates more frequently than every 2 years include revised understanding which would impose new requirements on quantification of CO_2 uptake or environmental safeguards and monitoring.	I know this is hard to prescribe a metric to, but I wonder if more transparent insight into what you consider "update" that is worth changing things for is. Difficult question, perhaps not solvable.	Future Versions
OAE v DOCS	Thank you for the comment. As Protocols are intended to be standalone documents, we will take this suggestion for a future blog post to help readers navigate the similarities and differences between OAE and DOCS.	As a general comment, I would find it incredibly helpful to have an overview of text that is equivalent to the OAE protocol, especially around efficiency loss requirements and appendix things. It was too much effort to try and cross check myself.	Introduction
	Thank you for the comment. Direct Ocean Capture refers to the technology for extracting carbon from seawater. Direct Ocean Capture and Storage refers to the complete pathway that results in net negative, durable CDR.	I would suggest to also be consistent with your DOCS acronym when spelling the pathway out, i.e., replace "Direct Ocean	Introduction

		Capture" with "Direct Ocean Capture and Storage" throughout the entire document	
	Crediting is ex-post. Quantification in each reporting period will only include uptake that has occurred up to the end of the reporting period. For more details on the crediting period, please see the Air-Sea CO_2 Uptake Module.	Could you please clarify - the model calculations occur prior to crediting, but are the credits ex-post or ex-ante with respect to the CO_2 drawdown calculated in the model? i.e. is a credit generated after the intervention occurs, or after the model says the CO_2 has been removed from the atmosphere?	Introduction
Description of DOCS requires improvement	The original sentence has been edited to "The CO_2-depletion in the discharged seawater compared to the natural ocean baseline causes carbonate chemistry to re-equilibrate, which then drives re-equilibration with the atmosphere via air-sea gas exchange."	and carbon equilibrium chemistry	Introduction
	Thank you for this point. Seawater alkalinity must be restored prior to discharge to be a net sink of atmospheric CO_2. As this sentence is only describing the process of removing DIC, it has been left unchanged.	Precipitating carbonates from seawater acts as a net removal of alkalinity from the ocean, or a net source of CO_2 to the atmosphere. Storage of DIC as solid $CaCO_3$ only makes sense if the alkalinity is sourced externally, not from the ocean.	Introduction
	Operability must not come at the expense of scientific rigor. Regarding thermohaline characteristics, temperature and salinity are prognostic variables in the ocean models used to quantify air-sea CO_2 uptake (see Air-Sea CO_2 Uptake Module for more details). The full 3D field (encompassing surface and deep water) is predicted at each time step and evolves throughout the duration of the simulation.	Considering that ocean water is part of a huge cycle with surface and deep ocean water behaving quite differently in terms of their thermohaline characteristics, will a protocol that is	Introduction

	Please let us know if there is a specific concern around effects which may be omitted in the current quantification strategy.	operationally easy to achieve give a true picture of the effects of DOCS protocol?	
	This is a really important point - the mechanism for durable carbon storage is already detailed in the subsequent parts of the Introduction, and throughout the Protocol where durable storage is discussed.	Might be worth clarifying that this would only be if the final storage method is not the carbonate precipitates formed through the base route (e.g., for the acid route or if the carbonates are calcined and the CO_2 stream captured)	Introduction
	Correct, only atmospheric CO_2 removal is credited, not the DIC removed from seawater. We confirm there is not a typo, so this has been left unchanged.	Probably a typo here. I guess it is only the CO_2 removed from the atmosphere (2) that is credited, not the DIC extracted and permanently stored in a durable reservoir.	Introduction
Practical implications of measurement and model data requirements, including publication of measurement and model data	Data generated from independent academic research is considered a third-party source. Academic institutions is included as an example in the preceding sentence.	if this includes academic, would specify so	Measurements for model validation and model inputs
	Geostrophic currents and their underlying pressure gradients are the foundation of large-scale ocean dynamics, but they are not relevant for modeling the immediate mixing zone of the plume. The geostrophic balance applies to large-scale (mesoscale and basin-wide) motions, where the Coriolis force balances the pressure gradient force and emerge typically on horizontal scales of ≥100 kilometers and time scales of days or longer. Models used in the near field and far field domain include the Coriolis force and equations of state for seawater to determine pressure gradient force, where geostrophic currents naturally emerge as a result of these forces (see Air-Sea CO_2 Uptake Module for more details).	Should also consider effects of geostrophic currents and pressure gradients.	Model set up

	The initial mixing zone is much smaller in scale (~100m) and is dominated by high-energy, small-scale processes such as jet momentum, turbulent shear, and buoyancy-driven spreading. For the mixing zone, we rely on mixing zone models to resolve these near-field dynamics to ensure rapid dilution and prevent local environmental threshold exceedances.		
	pH and TA must be measured to determine DIC. Bottle sampling of DIC is also needed for routine ground-truthing and validation.	No DIC for seawater influent and effluent?	Monitoring locations
	Hydrodynamic models solve the primitive equations (conservation of momentum, mass, energy, and salt) to accurately simulate the time-evolving ocean properties and circulation in a domain. This capability is essential because the fate of a discharge critically depends on the simulated currents and the specific density (from salinity/temperature) of the receiving water mass.	Such models need to take into account the nature of ocean water circulation in the area of interest and should consider the properties of ocean water depending on the water mass it will discharge into. For example, the salinity of RSIW and AAIW are quite different in spite of both water masses being considered as intermediate water bodies.	Near-field model
	Yes, any competent hydrodynamic model used for discharge studies must accurately simulate these processes, as they govern the 3D circulation and dictate where a discharged substance will be transported and mixed.	Will coastal divergence and convergence be considered during such a modelling?	Near-field model
	The primitive equations remain the same for all ocean models, however, the model domain setup, grid resolution, boundary conditions, and bottom friction parameterizations may be different to accurately capture the specific hydrodynamics of each margin type.	Will the modelling vary depending on the nature of plate boundaries. For example, will the modelling be same for an active continent-ocean boundary such as a subduction zone (like west coast of South	Near-field Modeling

		America) vs a passive margin (like boundary of continental India and oceanic plate of Indian ocean)?	
	This will be determined on a case by case basis. In many circumstances, a single study can be sufficient to characterize the dominant modes of variability in a parameter within the timescale of interest.	What is the metric here? Is one sufficient?Likely not? What could uncertainties be associated with this approach?	Ocean Monitoring Examples
	This section is a hypothetical example. The purpose of this sentence is to give context for the timescales associated with the hypothetical project activity (1 week) and residence time at the site (1 day). These timescales are used to help contextualize the suggestion for a 2 week monitoring duration, specifically for chemical parameters like pH. An appropriate monitoring duration needs to be determined based on the timescales associated with the project activitiy, residence time and the parameter being measured.	Is this whole section bespoke / only applicable for such shot PILOTS? Then I suggest saying so. Otherwise I find there is insufficient restriction/explanation of what constitutes sufficient "previous studies and literature" to warrant reducing the baseline observations so drastically.	Ocean Monitoring Examples
	Yes. Energy, transportation and embodied emissions for MRV, including sensors and monitoring infrastructure is within scope of the system boundary and must be accounted for in determining net negative carbon removal.	Will the energy requirements for all this sensors and monitoring infrastructure be also calculated while considering the net CDR?	Ocean Monitoring Examples
	To clarify this hypothetical example: two weeks is the duration of monitoring. The minimum frequency of monitoring is 6 hours, however with autonomous sensors, the monitoring frequency is likely to be every 15-30 minutes.	The local pH variation caused by natural processes maybe diurnal and seasonal but that has happened over a large amount of time and the biogenic effect will possibly smaller in scale compared to a full fledged commercial plant. So is the weekly or less frequent	Ocean Monitoring Examples

		measurement a good strategy to follow?	
	A control site is generally not required and additional approval is not needed.	approved by Isometric and/or VVB?	Ocean monitoring for ecosystem safety
	Ekman transport is a process that connects wind stress to vertical water movement such as upwelling or downwelling, making it an important primary driver of water column structure, temperature, and biological productivity along coastlines. Its effects are already captured within the list of features which must be described and characterized as part of pre-deployment.	How will Ekman transport affect the pre-deployment strategy?	Pre-Deployment Requirements
	Groundwater permits are not needed as this protocol is only applicable to surface water discharge.	What about groundwater?	Pre-Deployment Requirements
	This is required per Section 5.3: Ownership.	I suggest adding documentation of the owner of the removals, in the case of separate CO_2 capture and storage partners. VVBs will ask for this anyway, but it could help make sure project proponents have a statement about ownership in their initial agreement with the storage partner	Project Design Document
	Novel TA sensors can be used. Note that all sensors must be calibrated. Per Appendix 1: "Adoption of innovative sensor technologies is encouraged. For novel sensors, additional information that would typically be available from a manufacturer would also have to be provided. These include detection range, resolution, accuracy, performance under different environmental conditions (e.g. temperature ranges, depths) and response time. The expected measurement conditions must be within the sensor's range."	apologies, did not have enough time to read appendix, but are you saying novel TA sensors are now OK to use here?	Seawater influent and effluent
	Justification can include a written statement justifying very fast kinetics of	I'm not sure what would count as	Seawater influent and effluent

	aqueous speciation relative to external physical and/or biological forcings which affect the overall system. The equilibrium assumption can be checked by comparing calculated DIC against observed DIC from bottle samples. The discrepancy between the two should be within measurement precision or below a 5% materiality threshold.	sufficient justification	
Suggestions for inclusions and exclusions for what losses and emissions sources should be included in the System Boundary	Secondary precipitation of $CaCO_3$ is included as a near-field loss in Section 8.2.1.1.2: Step 2: Upscaling of DIC-depleted plume.	I suggest you do include secondary impacts due to $CaCO_3$ precipitation, as these are important and directly relevant to the efficacy of DOC and OAE.	Secondary Impacts on GHG Emissions
	We appreciate that MRV is an all-encompassing term and sampling specifically addresses the monitoring component of it, however we have decided not to change the language here.	not a fan of 'MRV' - wonder if 'monitoring requirements' is more adequate?	System Boundary & GHG Emissions Scope
	Yes, monitoring and emissions reporting requirements for CO_2 storage are contained within the respective modules.	Here as well as later on in leakage and storage assessments, it is not clear to me where monitoring of the storage (1) site is accounted for. I assume in the modules, but it could be worth clarifying up front.	System Boundary & GHG Emissions Scope
		similar comment as above – are emissions associated with storage (1) site monitoring part of that module or missing?	System Boundary & GHG Emissions Scope
	(combine with other comment on secondary GHG impacts) We have added dimethylsulfide production as a potential secondary impact on GHG emissions. These potential secondary impacts are uncertain and not included in the system boundary at this time.	Do you consider changes to dimethylsulfide?	System Boundary & GHG Emissions Scope
	(combine with shared infrastructure comment) At minimum, an allocation	How would this be allocated? This would	System Boundary & GHG Emissions

	scheme based on mass-flow usage of the infrastructure is required for emissions accounting. Over time, more complex algorithms for allocation of emissions for shared infrastructure may be developed and contractually agreed upon. These would be accepted by Isometric, so long as accounting is rigorous.	likely be shared infrastructure (same with CO2 transport)	Scope
	A reference to these modules has been added, which is now fully consistent with the OAE Protocol too.	I recommend adding an inline reference for this. It is a little confusing because it isn't an Isometric "module"	System Boundary & GHG Emissions Scope
Further clarification requested on socio-economic safeguarding sections	Unchanged. Transparent reporting around environmental and social safeguarding is dicussed in Section 6.1: Overarching Principles. "Following the Isometric Standard, Credits issued under this Protocol are contingent on the implementation, transparent reporting and independent verification of comprehensive safeguards. "	augment: conduct and publish with full transparency	Socio-economic Safeguards
	Thank you for the comment. We recognize the need to further codify the requirements around stakeholder mapping, engagement plan and verifiable records of outreach and responses. We have recently put an Environmental and Social Safeguarding Module into public consultation which houses these cross-pathway requirements.	Sorry for being a broken record here but as with all the protocols, this is subjective and hard to verify. We'd really appreciate more concrete language regarding who MUST be included in what situations. (e.g., shellfish farmers within x km of the project.) I know this is tricky and site-dependent but if the protocol does not include these details, verifiers have to make judgment calls that may not be consistent between different VVBs. Otherwise the only groups that must be included are "Indigenous Peoples and Local	Stakeholder Engagement

		Communities (IPLCs), stakeholders with land-tenure rights, local policymakers," which is also pretty vague.	
Standardization of marine protocols with enhanced weathering protocols	Standardization with other pathways supported by Isometric, such as enhanced weathering, was considered and will continue to guide protocol development. As the number of Isometric Protocols continues to evolve, we will no longer be referencing Isometric protocols in this Section.	Why the standards for ERW were not considered?	Sources, Reference Standards and Methodologies
How do VVB requirements intersect with Isometric requirements outlined in this Protocol?	VVBs do require this information for all sensors. This sentence describes how additional testing to determine detection range, resolution, and accuracy, of a sensor would be required if extensive testing has not been conducted for novel sensors by the manufacturer.	VVB should require this information for all sensors	Specific Guidance for in situ sensors
	VVBs, including sub-contracted consultants, are required to be independent and impartial, in line with Isometric's Conflict of Interest policy.	augment" "relevant and fully-indedepdent experience"	Verifier Qualifications & Requirements
Technical information needed to clarify quantification method for upscaling DIC-depleted plume	Due to the required frequency of measurement, it is recommended that DIC is measured using a combination of pH and TA. Routine bottle sample measurements of DIC is also required for ground-truthing sensor and equilibrium derived estimates.	Any requirements on how to measure DIC?	Step 1: Measurements of Seawater Carbon Capture
	Measurement frequency will depend on the variability in operating conditions. For example, more frequency measurements would be needed at the beginning of a project while the system is ramped up to a steady state. While the measurement frequency will be project and site specific, we expect frequencies around the following ranges: pH every ~15 min, TA daily at ramp up, weekly at steady state. The transition to steady state and any subsequent reduction in measurement frequency needs to be justified based on data collected demonstrating temporal stationarity.	How frequent?	Step 1: Measurements of Seawater Carbon Capture
		could use guidance on what frequency would be considered continuous monitoring for TA	Step 2: Upscaling of DIC-depleted plume
	Variability in seawater will affect the efficiency of CO_2 extraction from the DOCS process. However, this	Does this value vary depending on the type of seawater. In	Step 1: Measurements of Seawater Carbon

	measurement is conducted on the CO_2 stream rather than in seawater, and does not need to be adjusted based on seawater properties.	other words, does variability in salinity and temperature of the seawater affect this value?	Capture
	Thank you for the comment. pH and pCO_2 are not a recommended pair for constraining the carbonate system, especially due to the relatively high error for pCO_2 measurements near 0. As such pH and TA are preferred, or direct sampling of DIC.	This implies that DIC has to be measured, but the monitoring requirements below seem to suggest DIC can just be calculated from other carbonate system parameters, not measured directly. If it is calculated from pH and pCO_2, the uncertainty band may be so large that this check isn't super meaningful.	Step 1: Measurements of Seawater Carbon Capture
	For sensors, expect measurement frequencies > 1 sample per 15min.	Any guidance on sampling frequency? Assuming no DIC sensor	Step 1: Measurements of Seawater Carbon Capture
	If biotic calcification cannot be justified as a negligible loss, Project Proponents must quantify the loss and incorporate it into the CDR forcing function used to quantify air-sea CO_2 uptake. The specific strategy mentioned is a potential approach that Project Proponents may opt for.	Is this a recommendation or a must? How?	Step 2: Upscaling of DIC-depleted plume
	Interactions with sediments is also included as a required loss term further down in this section.	What about changes in sediments? Pore water chemistry is not typically resolved in ocean models. Should also consider changes in carbonate dissolution, not just precipitation.	Step 2: Upscaling of DIC-depleted plume
	The sensitivity study discussed here is used to sensitivity of the model output to the CDR forcing derived from the near-field model. Uncertainty in the CDR forcing is only one of many potential sources of uncertainty. Project Proponents must assess uncertainty of the dominant source of uncertainty using	Is this something that every model could resolve? Certain models could pass the sensitivity studies but still be incorrect because of improper nearfield	Step 2: Upscaling of DIC-depleted plume

	an ensemble of simulations. The output of the simulations produce a distribution of outputs. A final value of one standard deviation below the mean is used as a conservative estimate for CO_2 uptake. Please see Air Sea module for more details.	resolution of density gradients, turbulent mixing, etc.	
	This is a general comment on how abiotic calcium carbonate precipitation occurs in the ocean. The threshold for when precipitation occurs will depend heavily on local and project site characteristics. For example, existing studies have demonstrated that precipitation does not occur until saturation state >7 (Moras et al. 2022) or >30 (Ringham et al. 2024) depending on the site. As a general rule, marine carbon removal approaches will be efficient as long as calcium carbonate saturation state is not driven substantially higher than background seawater levels, which is a highly unlikely process to happen during Direct Ocean Capture.	What is the typical saturation point of calcium carbonate beyond which this process will not be suitable?	Step 2: Upscaling of DIC-depleted plume
	A mesocosm experiment with sediment grab sample is a potential strategy to constrain losses due to interactions with sediments.	Could this be done in a mesocosm with a sediment grab or does it have to be in situ? Presumably the thresholds should be established before the project begins, which would make it difficult to do an in situ study.	Step 2: Upscaling of DIC-depleted plume
	Thank you for the comment. As Protocols are intended to be standalone documents, we will take this suggestion for a future blog post to help readers navigate the similarities and differences between OAE and DOCS.	It would be helpful to include a discussion of how DOC is mostly not OAE in the intro. Maybe the TA vs DIC diagram from Zeebe & Wolf-Gladrow, 2001? That's how the Sophies explained it to me :)	Step 2: Upscaling of DIC-depleted plume
	There could theoretically be a model that incorporates these losses and thus subtracting the losses would be redundant. At present, these models do not exist. This can be due to a lack of a	Does this mean models that say they represent the losses may not or would you know if the model	Step 2: Upscaling of DIC-depleted plume

	validated mechanistic process for the loss. Even with a mechanistic process that could be incorporated into a model, these processes are likely to be treated separately from since the losses occur at must smaller and faster scales than resolvable by typical near-field and far-field models.	represents the losses? Is there theoretically a model that could represent all the losses and thus subtracting losses estimated from other means from the forcing function would be redundant?	
	Uncertainty is calculated using an ensemble of simulations from the ocean model to generate a distribution in CO_2 uptake. The uncertainty in ocean model is one standard deviation of the distribution of CO_2 uptake.	How is uncertainty calculated from the model used in calculating the CDR credit?	Step 3: Air-Sea CO_2 Uptake
What storage Modules are supported to be used in conjunction with this Protocol?	We recently added a module for CO_2 storage in depleted hydocarbon reservoirs.	What about depleted oil & gas reservoirs?	Storage of CO_2 removed from seawater