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Proceedings of the 2026 Carbon to Sea Annual Convening

Expanding the conversation on OAE's potential as a climate solution

CarbonToSea.org

Carbon to Sea Initiative

Foreword

DR. ANTONIUS GAGERN
CARBON TO SEA

In April 2026, we gathered in Halifax, Canada, for our fourth annual Carbon to Sea Convening, within the ancestral and unceded territory of the Mi'kmaq People. This region has become a central hub for ocean alkalinity enhancement (OAE) research and innovation. It is home to the longest-running OAE field research project; Carbon to Sea's largest academic research grant; one of the most successful academic-commercial research partnerships; a growing community of partners; and, most recently, Carbon to Sea Canada, which we launched at the Convening.

Our largest Convening yet reflected both the growth of the field and the widening circle of people helping shape its future. Our first Convening in 2023 was a gathering of a few dozen scientists to discuss their plans for the five-year R&D programs we just funded. This year, over 250 leaders from academia, non-profits, Indigenous communities, the fishing industry, private sector, and government came together to assess progress, confront challenges, and set the direction for what comes next.

In remarkably little time, OAE has moved from an idea to a sector.

In just a few years, OAE lab and mesocosm studies have started to build the mechanistic understanding of environmental impacts and efficacy across different alkaline feedstocks and receiving water characteristics. Leaders across academia, civil society, government, and the private sector are coalescing around approaches and conceptual frameworks for measuring and modeling OAE, making it possible to identify gaps and to build practical tools for field research. Through willing and passionate engagement of people who are working toward a safer climate and a healthier ocean, OAE research is rapidly growing in breadth, depth, and quality.

These Proceedings capture three days of site visits, presentations, panel discussions, and workshops. Two major themes stood out to me:

» **Field research is no longer a pipe dream.** Over the past two years, researchers have conducted many field experiments, ranging from less than one tonne to more than 1,000 tonnes of alkalinity added to seawater in highly controlled settings. These early trials show that current pilots are carefully planned, that rigorous environmental monitoring is possible, and that carbon dioxide removal is quantifiable through a combination of direct measurements and bespoke modeling. After deep-dive presentations of five field research efforts, there was a palpable sense of awe in the room about the progress made.

» **New perspectives are strengthening the field.** Just a few years ago, the OAE community consisted of a handful of researchers at a small number of academic institutions. Today, we have robust research happening around the world; an emerging startup ecosystem with ties to academia; increasing attention from governments; and genuine engagement from Indigenous communities, the fishing industry, and other ocean users. OAE is entering a new stage of development: one marked by a growing circle of participants, each with perspectives that will shape science, governance, and the field as a whole, and for the better.

Encouraging as these early bright spots may be, ocean alkalinity enhancement has not yet been proven as a viable carbon removal solution at a climate-relevant scale. The Convening highlighted a clear disconnect between the promise of OAE and the tools currently available to responsibly evaluate and advance it as we move into the increasingly complex phase of real-world demonstrations. Addressing this gap illuminates the next set of challenges we must overcome to build the trusted evidence that OAE can be safely and measurably deployed at scale.

» **Scaling independent scientific capacity through increased public funding,** which is essential to ensure that rigorous, objective research can complement the rapid innovation already being driven by advanced market commitments, ensuring the field progresses with the public interest as its North Star.

» **Operationalizing international governance frameworks** that move beyond high-level discourse to define clear, inclusive rules of the road. This transition must establish the non-negotiable guardrails necessary to protect marine ecosystems while creating the regulatory stability that incentivizes private sector innovators to align their operations with public interest.

Let me close by thanking everyone who made the Convening possible. We are grateful for the opportunity to bring this field together, and for the time, energy, and sincerity that you all bring to this work. I hope you'll remember the encouragement shared by Fawn Sharp and the Honorable Jonathan Wilkinson:

> Let's continue to "seize the opportunity" and "engage, engage, engage."

DR. ANTONIUS GAGERN
EXECUTIVE DIRECTOR
THE CARBON TO SEA INITIATIVE

Contents

Foreword 02

Contents 04

Acronyms 05

Opening Reflections 06

OAE Frontier Research, Knowledge Gaps & Field Tools 08

Efficacy 09

Safety 14

Field Research 20

Jonathan Wilkinson's Keynote Address 28

Governing oCDR: National Signals and International Frameworks 29

OAE Policy in Practice: National and Regional Case Studies 30

International Governance and oCDR: Needs and Opportunities 31

Exploring Markets and OAE's Place 34

Workshops 38

Indigenous Science Partnerships 39

Perspectives on Measurement Requirements for MRV 41

Learnings from Coastal Integrations for Open-Ocean Climate Solutions 43

A Path to Success: Expert Input on R&D Roadmapping 45

Lessons from Early Community and Policy Engagement 47

Assessing Environmental Risk of oCDR Projects with FEMM 49

Site Visits 51

Carbon to Sea thanks everyone who made the Convening possible, as well as Dr. Lydia Kapsenberg at CEA Consulting, who helped put these Proceedings together.

Acronyms

AAROM	Indigenous-led Aboriginal Aquatic Resource and Oceans Management organizations
BBNJ	Biodiversity Beyond National Jurisdiction
BECCS	Bioenergy with Carbon Capture and Storage
BiCRS	Biomass Carbon Removal and Storage
$Ca(OH)_2$	Calcium hydroxide
$CaCO_3$	Calcium carbonate
CARE	Collective benefit, Authority to control, Responsibility, and Ethics principles for Indigenous data governance
CBD	Convention on Biological Diversity
CDR	Carbon Dioxide Removal
CINCO	Chilean Cluster for Ocean Climate Innovation
CO_2	Carbon dioxide
ERA	Environmental Risk Assessment
FAIR	Findable, Accessible, Interoperable, and Reusable, technical data-sharing and management principles
FEMM	Framework for Ecotoxicological Modeling of mCDR
Gt	Gigatonne, a unit of mass equal to one billion metric tons
IPCC	Intergovernmental Panel on Climate Change
LC/LP	London Convention and London Protocol
LOC-NESS	Locking Ocean Carbon in the Northeast Shelf and Slope
mCDR	Marine Carbon Dioxide Removal, also referred to as "oCDR"
$Mg(OH)_2$	Magnesium hydroxide
MRV	Monitoring, Reporting, and Verification
NaOH	Sodium hydroxide
NDCs	Nationally Determined Contributions
OAE	Ocean Alkalinity Enhancement
OAEPIIP	Ocean Alkalinity Enhancement Pelagic Impact Intercomparison Project
OCAP	Ownership, Control, Access, and Possession, First Nations principles on data collection, protection, use, and sharing to support data sovereignty
oCDR	Ocean-based Carbon Dioxide Removal, also referred to as "mCDR"
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
R&D	Research and Development
UNCLOS	United Nations Convention on the Law of the Sea
UNFCCC	United Nations Framework Convention on Climate Change
WWT	Wastewater treatment

Opening Reflections

The 2026 Carbon to Sea Annual Convening was held in Mi'Kma'ki, the ancestral and unceded territory of the Mi'kmaq People. The spirit of the Convening honored the "Treaties of Peace and Friendship" and with it the past, present, and future caretakers of these lands and waters.

ELDER ANN LABILLOIS
DALHOUSIE UNIVERSITY AND MEMBER OF THE MI'KMAQ FIRST NATION AT UPGI'GANJIG, CANADA

Opening Prayer

LaBillois grounded the Annual Convening participants through her opening prayer, using an Indigenous breathing practice to emphasize presence, cultural respect, and the importance of ancestral knowledge as a foundation for scientific dialogue.

FAWN SHARP
INDIGENOUS GREENHOUSE GAS REMOVAL COMMISSION, QUINAULT INDIAN NATION, USA

Reimagining global finance for planetary survival through Indigenous leadership

Sharp shared her journey from frontline Indigenous leadership to global climate finance, calling for reimagined financial systems that bring together nature and blended capital through Indigenous-led design.

As first-term President of the Quinault Indian Nation in 2006, Sharp was introduced to collapsing salmon stock and glaciers in Washington, USA, and observed a failing political will to combat climate change in the United States.

> "It was in those moments that I began to understand that the value of Indigenous Peoples is indispensable to some of these challenges," she said.

Elected President of the National Congress of American Indians in 2019, Sharp and colleagues went directly after the fossil fuel industry and established new state and federal climate legislation securing funding for tribal nations, each success insufficient for the global scale of the problem. Two years ago, Sharp left politics to enter the world of global climate finance and was invited to join the World Economic Forum's Global Future Council. While initially inspired by international discussions on innovative finance ideas of valuing and trading nature, Sharp concluded it wasn't going to work. "Status quo markets by design are intended to maximize profit at the expense of nature, maximize profit at the expense of humanity, maximize profit at the expense of the planet. They're simply inherently incongruent with our values as Indigenous Peoples," she explained.

Centering the value of centuries of Indigenous ancestral knowledge and wisdom to create the solutions, she said, "We need to reimagine finance platforms and exchange and systems... where investment strategies actually follow ecological thresholds and where they actually follow planetary survival." Sharp acknowledged the importance for investors to see a return on their dollars, but the solution, Sharp said, "is returning to a system where there's a different definition of wealth, of value." Conversations on financial risk and environmental risk must be brought together. The path is emerging, she said, but "it's not something that's new and innovative...For Indigenous Peoples, the value of nature has been something that has been passed down through centuries and it's something that's embedded in our DNA."

Sharp closed by recognizing Carbon to Sea as part of this emerging solution and invited participants to seize this opportunity together, noting that

> "the beauty of a seized opportunity... multiplies, it creates momentum and it creates a movement."

Carbon to Sea Initiative

OAE Frontier Research, Knowledge Gaps & Field Tools

Efficacy

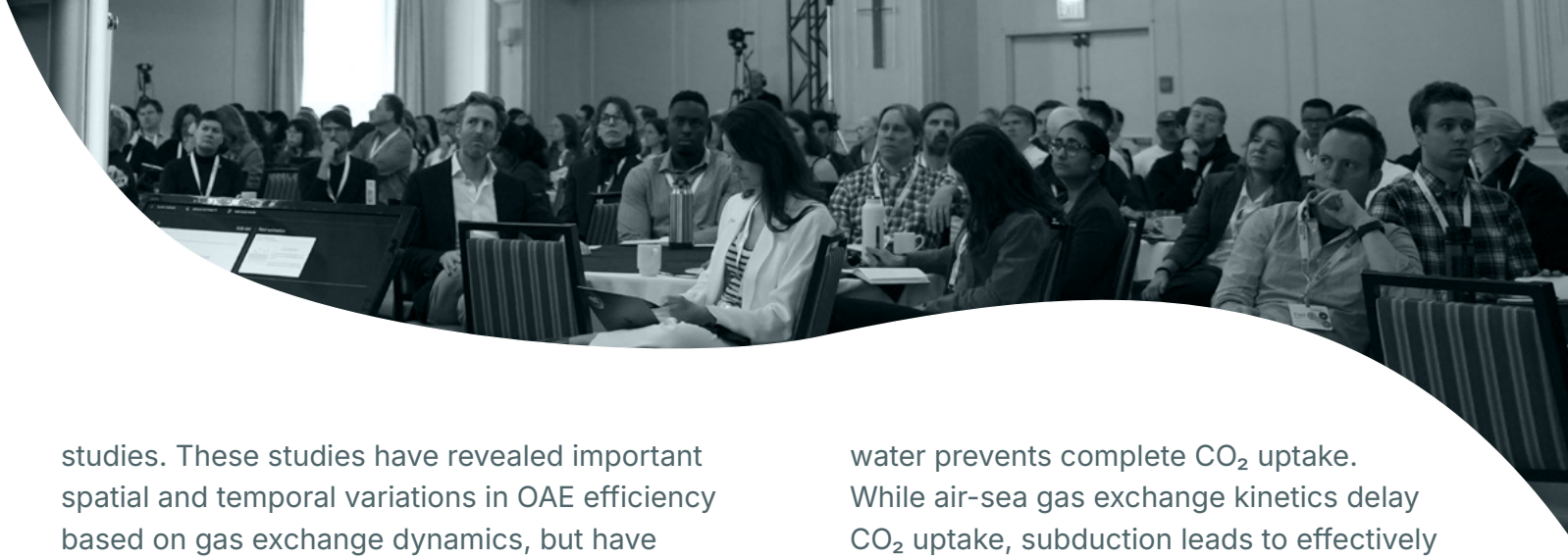
Core to the evaluation of ocean alkalinity enhancement (OAE) as a climate solution is scientific evidence that the chemistry and all other relevant ocean processes allow it to work as intended. Over the last few years, experiments testing OAE efficacy have advanced from answering how to increase alkalinity in seawater to what happens after alkalinity is increased in the ocean. Specifically, how does an increase in alkalinity lead to the uptake of CO_2 from the atmosphere and what processes can reduce the efficiency of CDR? Distinct processes of efficiency loss are now identified, and data from systematic lab experiments are beginning to inform where OAE will work best, how to minimize efficiency loss, and how site characteristics shape what OAE can deliver at scale. It also exposes gaps: mechanistic understanding of efficiency loss is still low, and scaling OAE to climate-relevant levels will depend on the choice of OAE pathway and site selection criteria that can vary dramatically over short distances.

Continued progress will require more field trials, with guidance from refined siting and deployment criteria.

DR. ABBY LUNSTRUM
UNIVERSITY OF PENNSYLVANIA, USA

Evaluating OAE through an efficiency loss framework

Setting the stage for several deep dives on OAE efficacy research, Lunstrum opened the session by introducing a conceptual framework for estimating OAE efficiency that systematically accounts for processes that contribute to efficiency loss. OAE efficiency, defined by Lunstrum as a metric of carbon dioxide (CO_2) removed per unit of alkalinity increase, is often reported in the context of air-sea gas exchange



studies. These studies have revealed important spatial and temporal variations in OAE efficiency based on gas exchange dynamics, but have not accounted for other chemical, mechanical, and biological processes that can affect carbon dioxide removal (CDR). Lunstrum presented a comprehensive framework that codifies OAE efficiency losses in four categories.

- **Incomplete mineral dissolution** occurs when dissolution kinetics are slowed or mineral sinking prevents the added alkalinity from contributing to CDR. Lunstrum explained that current models don't accurately constrain these processes, due to deviation from "local conditions, hydrodynamics, environmental factors, and the quality of the mineral itself." But more observations can help parameterize models to "figure out where the reality lies."

- **Loss to mineral precipitation** occurs when the added alkalinity triggers mineral formation in the seawater or sediment pore waters, thereby reducing alkalinity available for CDR. Precipitation thresholds can be informed by lab experiments, said Lunstrum, while precipitation in sediments is unknown and could be a significant source of efficiency loss. However, few published studies on this exist, and "more research across different types of coastal deployments" is needed, she said.

- **Incomplete air-sea equilibration** occurs when air-sea gas exchange kinetics are slowed and/or subduction of the treated water prevents complete CO_2 uptake. While air-sea gas exchange kinetics delay CO_2 uptake, subduction leads to effectively permanent alkalinity loss. This category has received the most research attention across studies of OAE efficiency, and Lunstrum explained that careful deployment design and site selection can help minimize such losses.

- **Loss from indirect impacts** occurs where the added alkalinity indirectly modifies other processes that govern seawater carbonate chemistry. This includes reduced production of alkalinity by sediments, increased removal of alkalinity via enhanced biological calcification, and changes to ecological processes. Indirect impacts have received the least attention, but Lunstrum hypothesized that the impact of these processes on OAE efficiency is likely small.

Lunstrum concluded that the knowledge base is expanding and

> "we are starting to know... which losses are important and which are not" for different pathways, she said, but "dozens of papers is not a lot."

Most efficiency losses are still poorly constrained, and the field needs more observations from different deployments to quantify efficiency.

DR. CHARLY MORAS
UNIVERSITY OF HAMBURG, GERMANY

Exploring mineral dissolution and sinking to inform optimal OAE regions

Focused on Lunstrum's first efficiency loss of incomplete mineral dissolution, Moras presented a research synthesis showing that colder, fresher ocean regions with a deep mixed-layer depth may be more suited for open-ocean particle-based OAE.

Moras reported on the effect of temperature, salinity, and grain size on the dissolution of calcium hydroxide ($Ca(OH)_2$), magnesium hydroxide ($Mg(OH)_2$), and olivine particles. Showing results from lab experiments, Moras demonstrated that some alkaline particles may dissolve more completely at colder temperatures (4-28°C tested range), lower salinities (24-38 tested range), and with smaller grain sizes (10-1000 µm tested range). Another study integrated the dissolution kinetics data into a particle sinking model. There, Moras showed how $Ca(OH)_2$ should dissolve within the first few meters of the water column and $Mg(OH)_2$ could sink faster than it dissolves.

Moras concluded that the highest dissolution efficiency could be achieved in colder, fresher waters with a deep mixed-layer depth to extend the time for particles to dissolve as they sink. The aim of this work, Moras explained, is to connect the dissolution kinetics and sinking data into general global models with vertical and horizontal mixing to

> "have an overview of the general potential of OAE for given materials around the globe."

Moras called for systematic research on dissolution kinetics and sinking dynamics to parameterize global ocean models as a path to identifying high-potential OAE deployments.

MATT QUINAN
UNIVERSITY OF SOUTHERN CALIFORNIA, USA

Introducing a lab-based approach to quantify OAE efficiency loss

Quinan presented an approach for parsing OAE efficiency loss of olivine weathering into its component processes, mineral precipitation

and incomplete dissolution. Quinan performed lab-based experiments where seawater was pumped through columns containing beach sand with 0, 1, 5, or 10 percent olivine over 4.5 hours. The experiments confirmed that alkalinity production increases with olivine concentration and residence time, but with diminishing returns. Pore water chemistry measurements pointed to two precipitation pathways: rapid uptake of dissolved inorganic carbon indicated calcium carbonate ($CaCO_3$) formation, and modest silicon uptake suggested possible kerolite formation.

To quantify OAE efficiency loss, Quinan used a stoichiometric dissolution model to compare his observations to theoretical OAE efficiency and parse the estimated loss into its component processes. Quinan showed that more than half of the alkalinity produced through olivine weathering was lost to secondary precipitation.

> “Secondary precipitation is a big loss, but that doesn't explain the diminishing returns,” he said.

Turning to the model results on dissolution kinetics, Quinan explained, “We see slower dissolution at higher olivine concentration, which is correlated with pore water pH.” One way to mitigate these losses, Quinan suggested, is to apply olivine in dynamic environments where waves and advection sweep dissolution products away from nucleation sites in sediments before they can precipitate.

While these findings are based on a single feedstock, flow rate, time point, and sediment type, Quinan's study illustrates a measurable approach to quantify OAE efficiency loss that can be applied to other OAE scenarios.

DR. KATJA FENNEL
DALHOUSIE UNIVERSITY, CANADA

Modeling a possible path from a single outfall to gigatonne-scale OAE

Zooming out from microscopic dissolution dynamics, Fennel explored what potential gigatonne-scale OAE might look like as a real-world operation. This requires understanding the maximum safe and effective amount of alkalinity that could be achieved at an individual coastal outfall and how many outfalls are needed to reach a climate-relevant scale of CDR.

Environmental conditions influence how much dissolved alkaline feedstock can be added to seawater before pH thresholds are breached. Fennel explained that the solution for getting alkalinity into the water is to dose dynamically, based on tidal and wind conditions: reducing alkalinity dosing during the relatively still waters of slack tides to avoid pH peaks and increasing alkalinity dosing when waters move swiftly because of tidal advection or strong winds. This strategy maximally maintains outfall pH at the regulatory and ecological safety threshold of pH 9. Using Planetary’s commercial OAE operations

in Halifax and an idealized modeling approach with a dissolved feedstock and no OAE efficiency loss, Fennel tentatively estimated that Planetary's site could theoretically deliver up to 28,000 tonnes of CO_2 removal per year. With such potential, reaching one gigatonne (Gt) would require roughly 43,000 similar outfalls globally.

Exploring other sites along the coast of Nova Scotia, Fennel used a metric called "effective diffusivity" based on physical site characteristics and ocean dynamics that acts as a proxy for alkalinity addition potential. High effective diffusivity indicates strong advection of alkalinity away from an outfall and greater CDR potential. To Fennel's surprise, effective diffusivity was highly variable over short distances and greater than temporal variations, leading Fennel to conclude that

> "picking the right location is the most important."

As neighboring outfalls can create "a buildup of alkalinity that limits CDR at any given site," Fennel explained, "If we want to scale up, we need to consider the whole configuration of different outfalls."

Reflecting on the field's recent progress achieving permitted field trials and measurable OAE perturbations, Fennel said "we have come a long way," pointed to efficacy, additionality, and scalability as "big open questions," and reiterated the need for field and modeling studies around the world to address them.

Safety

In addition to evaluating efficacy, potential risks and co-benefits of OAE must be understood. Dozens of OAE experiments on marine life over the last few years have revealed distinct sources of OAE's impact on biology: changes to carbonate chemistry (e.g., pH and whether alkalized water is pre-equilibrated with CO_2 before release) and for some pathways which use solid alkaline feedstocks, the introduction of particles and impurities (e.g., trace metals or nutrients). Early findings suggest that realistic alkalinity perturbations alone generally do not act as strong stressors on marine organisms, although few studies have looked at higher trophic level (e.g., fish) impacts.

The advancement in biological impact data has enabled the development of risk assessment and stage-gate tools to support project design, siting, and monitoring decisions, while ensuring minimal ecological risk of field trials. Research beyond phytoplankton and a focus on realistic OAE exposures remain research priorities.

DR. KAI SCHULZ
SOUTHERN CROSS UNIVERSITY, AUSTRALIA

Evaluating OAE safety by parsing the drivers of biological risk

Evaluating OAE impacts from a perspective of biological sensitivity to changes in carbonate chemistry, particles, and feedstock impurities, Schulz defined four OAE pathways by feedstock type and whether seawater was pre-equilibrated with CO_2, and presented a table of research findings for each category, contextualized by a +500 µmol kg-1 alkalinity perturbation.

» **Liquid, pre-equilibrated, OAE** (e.g., sodium hydroxide, NaOH, with CO_2): raises pH only slightly, from 8.0 to 8.05. Schulz identified this as likely the least impactful OAE perturbation because changes in biologically relevant carbon chemistry are minimal. Across 15 observations (studies/taxa/species), none identified impacts below a +500 µmol kg-1 total alkalinity addition. Only a few studies reported minor positive or negative changes in bacteria and phytoplankton metrics at

higher alkalinity treatments, and no effects were observed in zooplankton (two taxa, up to +2700 µmol kg-1 total alkalinity).

» **Liquid, unequilibrated, OAE** (e.g., NaOH): raises pH from 8.0 to 8.6, creating carbonate chemistry changes that can impair acid-base regulation and reduce primary production due to CO_2 limitation. Across 18 observations, both negative and positive effects were observed in phytoplankton, with negative effects emerging around pH 8.5 to 8.6, suggesting a relatively high safety threshold. Several studies investigated higher trophic levels and reported minimal effects around a similar pH threshold.

» **High-purity particle-based feedstocks, unequilibrated** (e.g., calcium and magnesium oxides or hydroxides): also produce a pH of 8.6, and so share the same carbonate chemistry concerns as the liquid unequilibrated OAE, with additional risks from direct particle interactions (e.g., ballasting of diatoms, gut impacts from particle ingestion, accumulation of particles in sediments). With only seven published observations, Schulz noted, this category is insufficiently studied to draw conclusions.

» **Low-purity particle-based feedstocks, unequilibrated** (e.g., olivine, iron, and steel slag): produce a pH range of 8.05 to 8.6, and so share both carbonate chemistry concerns as the liquid unequilibrated OAE and the particle risks of the high-purity pathway, with the additional risk of releasing trace elements that can either enhance primary productivity (e.g., silicate or iron) or prove toxic (e.g., nickel). With 38 published observations, this is the most studied particle category and the most variable in outcomes.

Schulz concluded that unequilibrated OAE creates the largest concern from a carbonate chemistry perspective and that particles and their impurities can introduce additional risks to marine life. Schulz pointed out gaps on higher trophic levels (e.g., molluscs and fish), but noted some are underway. While ecosystem services and food web impacts are not well understood, including impacts on fish, Schulz hypothesized that

> "when there are approaches which do not show effects on the base of the marine food web, it's hardly likely that we will see indirect effects on higher trophic levels."

DR. LENNART BACH
UNIVERSITY OF TASMANIA, AUSTRALIA

A fortifying evidence base for low-impact carbonate chemistry perturbations

Focused on carbonate chemistry risks, Bach presented new evidence consistent with the long-standing hypothesis that realistic changes in alkalinity (less than +500 µmol kg-1 total alkalinity) would generally not act as a strong stressor on marine organisms.

In a novel, global, capability-building collaboration – the OAE Pelagic Impact Intercomparison Project (OAEPIIP) – Bach coordinated 17 replicate phytoplankton experiments across all continents, using an NaOH perturbation of +500 µmol kg-1 total alkalinity in CO_2-equilibrated and unequilibrated conditions. With data analysis ongoing, Bach shared the group's preliminary findings indicating generally little to no effect on phytoplankton exposed to CO_2-equilibrated conditions and minor to moderate effects under unequilibrated conditions, consistent with Schulz's analysis. The aim of this work, explained Bach, is to "use mesocosms to identify groups that respond to a perturbation" and "extract overarching response patterns" to develop predictive mechanistic understanding that can be represented mathematically in a model and used to forecast biological risks of OAE.

Bach suggested that the next step is to acquire funding for identifying which phytoplankton groups are responding to the treatments and why. He also recommended expanding the approach developed in OAEPIIP beyond phytoplankton.

> "We need to ramp up on [studying] carbonate chemistry effects on bottom feeders, benthic organisms, and non-plankton organisms,"

Bach said, suggesting oysters as a possible next species and reiterating the importance of carbonate chemistry-focused research.

DR. JIAYING GUO
SOUTHERN UNIVERSITY OF SCIENCE AND TECHNOLOGY, CHINA

Complexity of biological response to olivine and steel slag impurities calls for informed scenarios

Focused on the biological risks of particle-based feedstock impurities, Guo demonstrated that low-purity feedstocks can have variable and context-dependent effects on marine organisms and presented emerging evidence that benthic species may be more vulnerable to leached metal than pelagic species.

Synthesizing published and unpublished studies, Guo presented experimental results on steel slag and olivine across a range of marine organisms. Both feedstocks leached metals including iron, magnesium, and aluminum, but their biological impact varied across geographies and independent studies. Phytoplankton appeared relatively resilient: one study found positive and neutral effects, but no toxic effects, of olivine leachate on two silicifying diatoms, a calcifying coccolithophore, and three cyanobacteria. Metal accumulation, however, was documented in diatoms, seaweed, bivalves, amphipods, and polychaetes, leading Guo to hypothesize that benthic organisms may be more vulnerable to feedstock impurities than pelagic organisms.

Whether this accumulation leads to biomagnification up the food chain remains unclear. For example, in one steel slag experiment, only magnesium accumulated in diatoms, with no subsequent bioaccumulation in krill. Given the complexity and variation of biological sensitivities and responses, Guo concluded that

> “Research is limited by the scenarios we are testing”

and called for practical considerations of feedstock availability, dosage, cost, and deployment location, to inform experimental design.

DR. GRACE ANDREWS
HOURGLASS CLIMATE, USA

Using risk quantification to turn complex data into practical decisions

Merging knowledge on carbon chemistry and feedstock impurity risks, Andrews introduced Hourglass Climate's FEMM: Framework for Ecotoxicological Modeling of Marine CDR (mCDR) and demonstrated how practical, real-world decisions can be made despite the complexity of OAE biological responses. FEMM is intended to support decisionmakers with site selection and environmental impact quantification and monitoring design.

A tension for ocean-based CDR (oCDR, also known as mCDR) projects is that

> "positive impact occurs at the global scale and yet... the potential negative environmental impacts occur at the local scale,"

Andrews said. Local communities bear that risk, and regulators have the challenging task of evaluating risks and benefits.

> "Rigorous risk quantification is a pathway to resolving this tension and allowing mCDR to safely scale," Andrews stated in her presentation slides.

FEMM's guidance document adapts an industry-established, quantitative Environmental Risk Assessment (ERA) approach for novel oCDR stressors and can be used as part of a broader environmental impact assessment to identify low risk project sites. "[FEMM] is a tiered approach," she explained, with a "simple screening level assessment, and only when risk is triggered at that basic level do we move into...mechanistic modeling and [dive] deeper."

Hourglass is now developing FEMMtool, an online application to conduct risk assessments based on metal toxicity data and carbonate chemistry stress. Hourglass Climate aims to build assessment tools that can "fit within the confines of an emerging industry while still being...protective and conservative."

SAM FAWCETT
PML APPLICATIONS, UK

A stage-gate framework for safely scaling OAE field trials

To provide accessible guidance for scaling OAE field trials without compromising safety, Fawcett presented the OAE Environmental Impact Monitoring Framework. This framework is designed to provide essential guidance for researchers, regulators, funders, industry stakeholders, and the public on how to evaluate the environmental impacts of OAE approaches during field research.

The framework describes a stage-gate approach across four scales of OAE operations — from planning to hundreds to thousands of tonnes of alkalinity addition through continuous alkalinity dosing — with specific aims, key activities, and advancement criteria for each stage. The publication is structured in two parts. The first part outlines environmental monitoring recommendations and the stage-gate criteria for evaluating safety and efficacy. The second part provides practical guidance for implementing the framework.

Projects that fail to meet either safety or efficacy criteria should not advance to the next stage. “All trials should be designed to anticipate possible impacts and prevent escalation where possible,” Fawcett said.

> “You cannot out-monitor risks once they've already occurred."

He emphasized that the most consequential decisions for environmental safety are made in project planning, siting, and dispersal design.

The framework was developed over two years and draws on scientific and grey literature, working group contributions, field operations experience, expert reviews, workshops, and public consultation. Fawcett explained that the framework “is intended very much to be a living document... to be updated as learnings, from hopefully future field trials, begin to emerge.”

Field Research

Over the last five years, OAE field research expanded from a single trial to 16 active or planned studies, spanning coastal, open-ocean, and industrially integrated settings. Field trials have confirmed that OAE research may be permitted, CDR is quantifiable, and zones of impact remain relatively small. Teams leading these trials are advancing not only OAE science but, through their engagement with communities, fisheries, and governance, are also shaping what responsible research and development (R&D) looks like.

This session highlighted the value of field-based research, coordination, transparency, and broad engagement, and surfaced the substantial effort behind each trial, the need for MRV protocols to keep pace with evolving scientific knowledge, and challenges around commercial research involving carbon credits.

IRENE POLNYI
CARBON TO SEA, USA

Expansion of OAE field trials in scale and around the world

Introducing the session on field research, Polnyi outlined the expansion of OAE field trials over the past few years and previewed projects that are currently planned for the years to come.

This outline began with Vesta's first trial in 2022, which used less than one tonne of alkalinity feedstock. Over the next two years, Vesta scaled its field work, Planetary began field work in Halifax with Dalhousie University, and four new entrants (Ebb Carbon, Vycarb, the University of Tasmania, and the University of Rhode Island) commenced field research. In 2025, several field studies scaled up to hundreds to thousands of tonnes of alkalinity feedstock addition, Planetary and CarbonRun certified their field activity with credits for the first time, and Woods Hole Oceanographic Institution conducted the first open-ocean OAE

trial. As of 2026, there are 16 active or planned field studies, with additional entrants including the Röst Marine Research Center, Blusink, Equatic, pHathom, Capture6, and Limenet.

In the coming years, projects are expected to exceed 10,000 tonnes of alkalinity feedstock addition and to expand geographically. "Most completed trials have been in North America, Norway, and Australia, but we're now seeing planned studies expand into Europe, Africa, and Asia, helping to provide a more complete global picture," Polnyi said. On research priorities, she noted that "environmental impacts and MRV (monitoring, reporting, and verification) questions dominate [the field trial] research agenda." More than half of the field studies are led by OAE companies. Polnyi highlighted their critical contributions, saying,

> "in a field with limited demonstration opportunities and real funding constraints, [commercial] partnerships are really important to advance the science that builds credibility with policymakers, communities, and investors."

She also encouraged the private sector to share their work with the academic community. Polnyi introduced the session speakers: three leaders of field trials and three leaders of projects that contribute to improved field trial outcomes, accountability, and transparency.

DR. ADAM SUBHAS
WOODS HOLE OCEANOGRAPHIC INSTITUTION, USA

Demonstrating measurable CDR in an open-ocean OAE trial

Subhas presented preliminary results from the LOC-NESS project (short for Locking Ocean Carbon in the Northeast Shelf and Slope), the first open-ocean OAE field trial. These findings notably include how the team was able to directly observe and quantify CDR during the trial.

In August 2025, Subhas and his team of scientists, engineers, and support staff added 65,000 liters of NaOH (a 48-tonne CDR potential) and a Rhodamine water tracer dye, to 0.4 square miles in the Gulf of Maine and tracked the patch for four days using multiple vessels, autonomous vehicles, and remote sensing. The NaOH created an initial pH spike up to 8.3 that returned to its background state within 4 days. CDR was measurable within two days of the NaOH application, but Subhas detected a 15 percent loss of alkalinity, which he attributed to likely mineral precipitation of $Mg(OH)_2$. "This

material will precipitate out from seawater and then sink out of the mixed layer," he said.

Using in-water data and satellite images, early analyses suggest that the NaOH-treated patch absorbed approximately three tonnes of CO_2 over the four-day observing period.

> "CDR is measurable if you are in the right place at the right time," said Subhas, noting that CDR would continue for one year.

Subhas's team also observed biological conditions inside and outside the treated water, and preliminary data analyses suggested no significant biological impacts on phytoplankton health or on phytoplankton, zooplankton, fish larvae, and lobster larvae density. Subhas described the trial as a "heroic effort" and thanked all those who engaged in the project. Data analysis is ongoing and Subhas expects to publish the research by early 2027.

DR. MALLORY RINGHAM
EBB CARBON, USA

Derisking and scaling electrochemical OAE at Project Macoma

Ringham presented results from a six-month field trial of Ebb Carbon's research pilot in Port Angeles, Washington, USA in preparation for commercial integration of their technology in desalination plants. Ebb Carbon uses an electrochemical OAE system that removes hydrochloric acid from desalinated seawater (brine) and returns liquid, unequilibrated, NaOH-based alkalinity back into the ocean.

The team secured a permit that routinely allowed for alkaline releases of up to pH 9.8, followed by rapid dilution in a defined mixing zone. The high pH limit enabled the scientific research to evaluate "the boundaries of safe operation" and "see in water signals over long periods of time," Ringham explained. Before any alkalinity release took place, the team conducted extensive engagement with the local communities, including the Tribes that serve as co-managers of Washington's coastal and

marine resources, as well as oceanographic modeling and environmental and risk characterization, including for mussels and fish.

> “Some of that was permit mandated. Some of it was scientific. A lot of it was voluntary. And all of it was expensive,”

said Ringham, emphasizing the importance of private-public coordination in oCDR development.

The team successfully achieved sustained OAE perturbations, with only small shifts in pH within the range of local natural variability. The permit allowed for short-term alkaline releases as high as pH 12 for scientific research, allowing the team to test pH control and mineral precipitation dynamics. “It is possible to release high pH alkalinity without forming brucite,” Ringham said.

The field trial enabled scientific collaborations, confirmed desalination cobenefits, and delivered carbon credits under a pre-purchase agreement with Stripe. Commenting on the trial’s success, Ringham said, “We learned enough from this pilot to be able to move into commercial integration with desalination,” and noted an upcoming pilot project with the Saudi Water Authority, in Saudi Arabia.

DR. WILL BURT
PLANETARY TECHNOLOGIES, CANADA

Showcasing the critical role of commercial deployment for OAE progress

Burt shared lessons from Planetary's field operations, addressing progress, operational realities, and headwinds that slow progress. Planetary has been operating in Tufts Cove in Halifax, Nova Scotia, Canada for over two years, adding crushed minerals to the harbor that achieve expected alkalinity changes, demonstrating that CDR is measurable and paving the way for credit deliveries.

Contextualizing the zone of impact in the bay, where measurable pH and alkalinity excursions occur, Burt said the amount of water that sees +500 µmol kg-1 alkalinity is roughly the length of both his arms, illustrating the small local footprint of, what Burt called, “one of the most significant CDR projects in the world.” For his team, meeting expectations for environmental safety is “the biggest cause of reaction, stress, and work,” he said. Evaluating ecological safety requires long-term operations and extensive monitoring

(Planetary conducted 36 boat surveys in the last 12 months alone), which is funded in part by credit sales.

> “Commercial remains a word people don't like to talk about,” said Burt, but “credit revenue is the only reason this project is still going and facilitating all the learning that we are doing.”

Delivering credits requires tight operations and data management, complex calculations (including detailed accounting of all emissions), and detailed justifications, all of which are closely scrutinized by verification bodies.

> “[However], the notion that [OAE] is not something that can be regulated is simply not true,” Burt said.

Planetary’s work has helped spur progress in OAE regulatory structures, governance, and co-creation of research, but headwinds remain: pilots are few, OAE is not certifiable in some jurisdictions, and some OAE companies are reducing their affiliation with the ocean to avoid governance challenges. Burt called for greater unity in the field and thanked the community supporting Planetary’s work.

DOUGLAS EDWARDS & DR. BRENNA BOEHMAN
VESTA, USA

Preparing olivine beach nourishment for industrial-scale integration

Edwards and Boehman shared results from Vesta’s largest field trial and announced the development of an “Impact Review Board” to govern olivine placement in the ocean.

In 2024, under a construction permit with a research component, Vesta placed 8,300 tonnes of Norwegian olivine sand at 7 m depth, 450 m offshore of Duck, North Carolina. Like Burt, Edwards underscored the contrast between the project's scientific significance and its operational scale:

> “It was hard to find a contractor that was willing to engage in a project this small."

Based on the first year of independent monitoring by Hourglass Climate, Boehman confirmed that alkalinity was generated

with minimal ecological impact, with benthic disturbance and recovery consistent with typical beach nourishment studies. On trace metals, nickel increased in benthic and marine organisms but remained within natural coastal ranges and well below regulatory thresholds; cobalt remained within baseline; and chromium was not detected.

Vesta plans to integrate with industrial partners through a regional hub model that identifies scalable locations: places where olivine is available, seawater is warm, coastal dynamics optimize efficiency, and ecological impacts can be minimized. To advance responsible governance, Vesta is also developing an independent "Impact Review Board." With members appointed by Vesta and by the Grantham Foundation, the Board will have binding authority to approve or reject future olivine placements in the natural environment.

AUDRIA DENNEN
RÖST MARINE RESEARCH CENTER, ICELAND

Preparing an Icelandic fjord for a dedicated and collaborative OAE research site

Dennen announced plans for the Röst Marine Research Center's first OAE field trial in an Icelandic fjord. Röst was formed by Carbon to Sea in 2024 to develop the first dedicated OAE field site in Europe.

Röst's field site is located 40 minutes north of Reykjavík, in Hvalfjörður fjord, which Dennen described as one of Iceland's largest and most famous fjords. The site sits at the back of the fjord, largely isolated from open ocean dynamics, conditions that Dennen said are ideal for OAE research. In preparation for the 2026 field trial, the team spent the last two years collecting baseline data, and conducting a dual-tracer and a rhodamine dye release study in collaboration with [C]Worthy, making Hvalfjörður the most extensively measured fjord in Iceland. The site hosts a long pier, a pier house, an alkalinity dispersal rig, a nearby workshop, and arrays of sensors and other instruments. This year, the team also introduced a dedicated uncrewed surface vehicle (USV) from Open Ocean Robotics named "Sula," after an Icelandic seabird. The USV is the first of its kind to be specially equipped for OAE-related studies using in-situ carbonate chemistry and biological sensors, as well as a winch for conducting depth casts.

> "Building collaborative relationships, both locally and globally, is a must for us,"

Dennen said, noting partnerships with local industries; the Marine and Freshwater Research Institute of Iceland; the University of Iceland to engage students in ocean and climate science; and international collaborations including the UK's National Oceanography Centre for a sensor intercomparison project using Sula and [C]Worthy for development of a regional high-resolution model.

> “We support robust research by offering a dedicated field site and infrastructure with an emphasis on creating collaborative networks and transparency,”

Dennen said, adding that all their data will be open-access and inviting the audience to participate in the planned OAE field trial to conduct monitoring and observational studies.

SARAH SCHUMANN
FISHERY FRIENDLY CLIMATE ACTION CAMPAIGN, USA

Designing fishery-sensitive OAE research for improved outcomes

Schumann explained how fishermen can improve research outcomes via “fishery-sensitive mCDR,” a term she and her colleagues coined to describe “OAE and other forms of mCDR that are more attuned to, and more compatible with, the objectives of sustainable fish production and harvesting.” Referencing the LOC-NESS project field trial, Schumann described how engagement with the fisheries community led the LOC-NESS team to adjust the field trial's location and timing, extend their sampling to include fish and lobster eggs and larvae, and conduct additional lab experiments on zooplankton.

> “The LOC-NESS trial is just the beginning of what it can look like when members of the fishing industry help shape the field of OAE,”

Schumann said. She recommended fishing community engagement for co-designing research questions, methods, and analyses; conducting cooperative research using fishermen's boats and gear; embedding fishing industry observers in field trials; engaging fishermen in planning and decision-making by broadly informing the fleet; and formally granting a subset of community members direct, ongoing roles in shaping the project.

Schumann advocated for fishing and coastal communities to engage in activities that shape the future of OAE, such as setting research agendas, defining research standards, informing funding commitments, and crafting public and private governance frameworks. Schumann invited the audience to converse with her and her colleagues in attendance on how to ensure that community voices carry real influence over activities that could impact their lives, from local field trials to the future operations those trials may eventually enable, and how to do so without overburdening those who participate.

JACKI LONG
SUBMARINE SCIENTIFIC, USA

Standardizing OAE field data and accessibility

Long introduced new data tools designed to enable open-access data publication and synthesis across OAE research projects. Last year, the team published the first OAE oceanographic data management protocol on the Carbon to Sea website to standardize data publication and enable comparisons across projects.

Submarine Scientific is now developing the tools that go along with the protocol: a "metadata builder" to help data managers submit standardized metadata, and a "search portal" where users can find links to open-access data and request access to unpublished data. The search portal features a verification badge, identifying projects that comply with the protocol. The metadata builder is live, and the search portal is expected to go live in fall 2026.

Long demonstrated how to access metadata, data, and the filter mechanisms. The Submarine team is currently integrating data from Planetary, the LOC-NESS project, and the RMRC.

> "This is a very foundational step to allow acceleration of research," Long said, "because it standardizes the data across... projects so that people can actually interpret the data ...without doing a lot of legwork of getting it standardized themselves."

Long acknowledged and thanked the more than 100 individuals who contributed to the project.

Jonathan Wilkinson's Keynote Address

The Honorable Jonathan Wilkinson has dedicated his career to advancing climate solutions through his leadership in both government and the private sector in Canada. As a Member of Parliament for North Vancouver Capilano, Wilkinson has served as the Minister of Fisheries, Oceans, and the Canadian Coast Guard; Minister of Environment and Climate Change; and most recently the Minister of Energy and Natural Resources.

During his time in government, Canada launched its first carbon management strategy, passed the Net Zero Emissions Accountability Act, and expanded protected Canadian oceans from 1 to 14 percent. Prior to entering public service, Wilkinson spent two decades leading clean technology companies, giving him a unique perspective at the intersection of climate policy and private-sector investment.

In his keynote address, Wilkinson outlined Canada's opportunity to become a global leader in OAE R&D. He called for increased collaboration between the public and private sectors, alongside a federal research strategy for oCDR, more robust governance frameworks, and clearer regulatory pathways. Acknowledging the global economic challenges facing Canada today, Wilkinson argued that addressing climate change and building a strong economy are "entirely complementary."

> "Climate change and its impacts are a matter of science, not politics, but how we choose to respond remains a fundamentally political decision," he said.

He called for an "economy-wide approach" to address climate change that combines emission reductions with investment in emerging climate technologies. Highlighting OAE's potential, Wilkinson said it "can be one of the few carbon removal pathways that are very large scale, relatively low impact, and cost competitive." He also emphasized how Canada's coastline, existing infrastructure, and world-class scientific institutions provide an opportunity for Canada to lead and enable the oCDR field. Canada, he noted, is already home to some of the most advanced OAE research to date.

Looking ahead, Wilkinson identified several priorities for enabling responsible growth, including a federal research strategy for oCDR, increased investment in responsible R&D, robust MRV systems, coordinated regulatory pathways, and the development of offset protocols. He also encouraged Convening participants to "engage, engage, engage" and help identify champions within government who can advance this work. He said, "Canada has the scientific institutions, the regulatory culture, the ocean expertise, and ongoing project activity required to determine credibly whether, where, and under what conditions OAE deserves a place in a future climate toolkit."

Carbon to Sea Initiative

Governing oCDR: National Signals and International Frameworks

OAE Policy in Practice: National & Regional Case Studies

DR. SYLVAIN DELERCE
CARBON GAP, UK

Delerce outlined opportunities for OAE in Europe, such as the Carbon Removals and Carbon Farming (CRCF) Regulation, as well as upcoming research funding programs. He emphasized the importance of making today's research more visible for policymakers and stakeholders; building alignment across science and NGO communities; and the need for strategic engagement at both the member states and the EU Commission.

DR. MARIAM MAKU SWALEH MWASARIA
TECHNICAL UNIVERSITY OF MOMBASA, OCEAN CLIMATE INNOVATION HUB, KENYA

Swaleh shared her work engaging researchers and governments across Africa to develop an African mCDR Roadmap. This effort centered on regional priorities (such as economic development and developing solutions that are science-based, safe, and locally-led) and unique resources (such as a young workforce, 30,000 kilometers of coastline, and emerging policy frameworks) to create a first-of-its-kind set of regional recommendations for oCDR development.

MARÍA JOSÉ URRUTIA
CHILEAN CLUSTER FOR OCEAN CLIMATE INNOVATION (CINCO), CHILE

Urrutia highlighted her work with CINCO to build Chile's potential as a global hub for ocean climate solutions, taking advantage of its coastline, infrastructure, manufacturing industries, developed R&D ecosystem, and strong public-private partnerships. CINCO's work includes a first-of-its-kind pilot exploring the use of ground mussel shells, currently seen as waste by local industries, as a source of alkalinity, as well as critical efforts to attract international climate finance and build a local political constituency in support of climate innovation.

DR. YUWAN MALAKAR
COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION, AUSTRALIA

Malakar provided an overview of the Australia CDR roadmap, the first in the world to include an ocean-based method (OAE) as a potential novel approach to explore. Malakar shared details on how this roadmap builds on and supports Australia's Net Zero greenhouse gas emissions target, as well as its commitment to ocean protection, showing how novel CDR methods like OAE may safely contribute to the achievement of those targets. Further, Malakar shared parallel work CSIRO has conducted to evaluate community responses to oCDR, a key priority for the research agency.

DANIEL KELTER
CARBON REMOVAL CANADA, CANADA

Kelter provided the context of CDR policy in Canada, highlighting the opportunity for Canada to invest further in oCDR, identifying the gap between investments in terrestrial vs. marine methods. Kelter noted the recent Canadian Senate Report calling for Canadian leadership in developing a regulatory framework for oCDR and emphasized the need for a national oCDR strategy.

DR. PAUL HALLORAN
UNIVERSITY OF EXETER, UK

Halloran presented on the science-to-policy pathway that he has engaged with following the United Kingdom's investment in oCDR via the SEACure Project. Halloran provided context on how these investments in oCDR map to the UK government's efforts to develop a coherent strategy for their compliance market (UK ETS). He also provided key insights on where government engagement and partnership have been most fruitful from a science perspective, and opportunities for oCDR methods to follow in the path of other novel forms of CDR.

International Governance and oCDR: Needs and Opportunities

This session opened with an overview of the existing multilateral governance frameworks and their applicability to oCDR, presented by **Dr. Romany Webb** of the Sabin Center for Climate Change Law, Columbia University, USA.

Webb explained that the international legal landscape for oCDR is highly fragmented, with numerous international agreements potentially relevant to different techniques. These agreements were largely adopted before oCDR emerged as a climate solution and would require adaptation to govern new ocean-based carbon removal activities.

The two main agreements governing climate change, the UN Framework Convention on Climate Change and the Paris Agreement, both include language highlighting the importance of protecting or enhancing natural carbon sinks. While there has been an increased focus on the ocean and marine sinks in some national climate policies, this remains limited to nature-based blue carbon activities. In order for novel approaches like OAE to be included, a formal methodology from the Intergovernmental Panel on Climate Change is required; work on CDR methodologies has largely focused on terrestrial work so far. An additional area where this becomes operationalized is within the rules under Article 6 of the Paris Agreement that govern emissions trading, with the first bilateral agreement on offshore sub-seabed storage signed last year.

The London Convention and London Protocol (LC/LP), created to regulate marine pollution from dumping, has emerged as the primary international framework governing oCDR. Over two decades, the parties have evaluated when oCDR approaches constitute dumping. A 2008 resolution, issued in response to an early ocean fertilization project, allowed limited research while deferring deployment. A 2013 amendment on marine geoengineering followed, codifying this approach for ocean fertilization specifically. This amendment isn't yet in force, having been ratified by only nine of 56 parties, and the path forward remains unclear. Since 2022, the parties have been developing assessment frameworks for OAE and biomass cultivation and sinking, having

indicated they intend to take the same approach of allowing research while deferring deployment. Major open questions include the fate of the 2013 amendment and how a pathway toward deployment might eventually be established.

Other international agreements, such as the United Nations Convention on the Law of the Sea (UNCLOS), the Convention on Biological Diversity (CBD), and the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention), have largely deferred to the London Convention and London Protocol. The 2023 Biodiversity Beyond National Jurisdiction (BBNJ) agreement contains provisions with potential oCDR implications. Its relevance remains an open question since it only entered into force in January and has not yet held its first Conference of the Parties.

Webb's presentation was followed by a panel conversation that, in order to encourage candid engagement from panelists and audience members who are or have been government officials, was held under the Chatham House Rule. As a result, only a limited, general overview summary of the session is provided. The panel of governance practitioners included policy advocates and former government negotiators:

SUE BINIAZ
FORMER DEPUTY LEGAL ADVISOR AT THE US STATE DEPARTMENT, YALE UNIVERSITY, USA

DR. CHRIS VIVIAN
FORMER UK DELEGATE TO LC/LP AND OSPAR, FORMER NATIONAL MARINE ADVISOR FOR CENTRE FOR FISHERIES, ENVIRONMENT AND AQUACULTURE SCIENCE, UK

DR. ALICE ALPERT
ENVIRONMENTAL DEFENSE FUND, USA

ANNA-MARIE LAURA
OCEAN CONSERVANCY, USA

TOM PRAVDA
CLIMATE HUB, UK

Panelists shared insights from their experiences working within multilateral governance fora, highlighting areas of misalignment, opportunities to build political will, and potential pathways forward.

Exploring Markets and OAE's Place

CAROLINE OTT
CARBON TO SEA CONSULTANT, USA

State of the abiotic oCDR market

Ott opened the session with a snapshot of the abiotic oCDR market, inclusive of OAE and other non-biologically mediated oCDR pathways such as direct ocean capture and bicarbonate storage. The abiotic market consists of 30 active suppliers and a collective investment of more than $372 million across private capital, public funding, and credit sales.

Of these 30 suppliers, 16 have sold carbon credits through either pre-purchase agreements (funding provided upfront) or offtake agreements (price and volume negotiated for future delivery). Credit deliveries are small but growing, totaling just over 3,000 tonnes across four companies. Credit pricing is still highly variable, averaging from $700 to around $1,700 per tonne of CO_2 and may not reflect the true cost of removing and storing the carbon. There are 13 known buyers, with Frontier leading on the total number of contracts.

With the private sector contributing more than 60 percent of all abiotic oCDR R&D funds, Ott concluded that current public and philanthropic funding is insufficient for independent evaluation of its safety and efficacy, given the remaining scientific uncertainties. She further cautioned that while private sector activity can enable a portion of necessary learning and evaluation, a sector that commercializes too quickly may introduce risks that slow or preclude sector development in the medium to long term. Ott emphasized,

> "We want to ensure that the enabling conditions for a market exist and are in place if OAE is proven safe and ready for scale."

The following panel discussion explored the role of the commercial sector in advancing OAE knowledge and markets. Panelists represented a diversity of views and reflected on the most constructive role for the commercial sector over the next few years, the biggest risks if they get it wrong, and which forms of market activity are appropriate at this stage of the field's development.

DANNY BROBERG
STRIPE CLIMATE & FRONTIER, USA

Unlock demand to scale CDR and "get it right"

Viewing a CDR compliance market as the end goal, Broberg said the near term priority is to "build up markets and get buyers to invest." He added, "The biggest risk is that we don't solve climate change," and acknowledged that oCDR is not yet ready to scale, philanthropy alone cannot prove out oCDR technologies, and building the political momentum for a compliance market could take 10 to 15 years.

> "The goal is a baton pass from private sector to government,"

Broberg said, positioning the CDR market as the mechanism to "balance the speed to scale with getting it right." However, buyers are constrained by unsubsidized, high credit prices and uncertainty around the utility of credit claims. Unlocking demand, Broberg said, requires government co-investment, addressing claims, and on-ramps to the compliance market. Frontier's advanced market commitment of $1 billion by 2030, which currently supports 12 oCDR suppliers, aims to prove that CDR can be done responsibly and set the highest possible bar for a transparent carbon market. "We need to pause, make sure we get it right," Broberg said, "but we can't wait 15 years."

LUKE CONNELL
CARBONRUN, CANADA

Priming policy and community engagement to stay competitive

Priming policy for oCDR is critical, said Connell, explaining OAE could be left behind if other CDR pathways shift into a compliance market. Connell explained how California is working on procurement and is considering oCDR, and that getting excluded would send a bad signal to the market. Emphasizing the importance of oCDR not falling behind other ocean-based climate solutions, Connell said,

> "We're all in one pathway of marine-based CDR and that fits in with a peloton of many other pathways like direct air capture, BECCS, BiCRS, and biochar, which are moving quite far ahead on execution and sales."

At a project level, Connell explained that responsible scaling needs community engagement, early and often, at a pace that matches the community. He highlighted a recurring disconnect in which developers secure projects and funding without bringing community members into the room. He described a CarbonRun field site in which

framing the work as an “acid rain management project, supported by climate funding” helped earn local support. Done right, Connell argued, “[community engagement] can turn into tailwind rather than headwind."

JOACHIM KATCHINOFF
CREW CARBON, USA

Simplifying MRV and scaling via co-benefits

Citing MRV as one of the biggest current challenges for oCDR, Katchinoff explained CREW Carbon’s approach to “shrink the problem.” CREW optimizes alkalinity within wastewater treatment (WWT) facilities, where microbes digest waste and produce CO_2. By adding alkalinity, that CO_2 is captured within an engineered closed system with flowmeters, thereby making MRV more readily achievable compared to open system OAE approaches. The alkalinity also increases the biological efficiency of pollutant removal by microbes and thereby improves WWT infrastructure, so much so that one plant in which CREW operates is considering deferring an expensive infrastructure upgrade.

> “Integrating technologies that have co-benefits or co-drivers...is really important to scaling these technologies,”

Katchinoff said. He cited environmental benefits of CREW’s approach, explaining that wastewater treatment systems are controllable, dosing can be stopped if something doesn't work, and that by adding alkalinity WWT plants enhance their capacity as environmental stewards.

DR. CELINA SCOTT-BUECHLER
DUKE UNIVERSITY, USA

Building public trust and equity into the CDR market

Citing public trust as a key barrier to scaling the OAE industry, Scott-Buechler advised commercial actors to pursue “high-quality projects that have communities involved, engaged, and co-creating, so that [communities] can be stewards of the story of what mCDR can be.” This requires clarity about what CDR can and cannot achieve and prioritizing decarbonization. She encouraged sharing lessons learned and acknowledged the challenge of rightsizing community engagement on high-impact opportunities and small budgets.

Thinking beyond small projects, Scott-Buechler shared her vision of achieving a livable, equitable world and warned that

> “Building equity into governance systems after the fact is near impossible, if not impossible.”

She applied this same logic to market design, cautioning against repeating direct air capture’s path of fitting into compliance markets that weren't built for it, and urged the field to consider payment for research and activity, rather than credit delivery “in order not to get our wires crossed and not create perverse incentives that we’ll regret later,” before the transition from voluntary to compliance markets locks the wrong structures in.

JOHN MIMIKAKIS
ENVIRONMENTAL DEFENSE FUND, USA

Safeguarding the ocean while advancing credible solutions

Acknowledging the need for climate solutions but expressing skepticism of early crediting, Mimikakis advised commercial actors to engage in governance to prevent regulations from squelching innovation or becoming "too permissive, allowing bad actors to damage the environment and public trust." Mimikakis called for a shared understanding of a pathway to scale that enables innovation and also clearly protects the ocean throughout different phases of research, development, and deployment. Mimikakis illustrated his perspectives with an analogy:

> "Tech developers see the mountain as an obstacle to get the rock up. Environmentalists worry that the mountain is the slippery slope on the other side,"

he said, cautioning a lock-in risk if poor solutions are allowed to scale. Responsible scaling, he argued, requires standards and criteria to "thresh the good solutions from the bad, to ensure there is an on-ramp for good solutions and an off-ramp for the bad ones."

Workshops

To leverage the collective breadth of expertise amongst the participants, the second day of the Convening included six topical workshops:

- Indigenous Science Partnerships
- Perspectives on Measurement Requirements for MRV
- Learning from Coastal Integrations for Open-Ocean Climate Solutions
- A Path to Success: Expert Input on R&D Roadmapping
- Learning from Experience: Takeaways from Early Community and Policy Engagement in oCDR
- Assessing Environmental Risk of oCDR Projects with FEMM

The workshops aimed to share insights, feedback, and new ideas on OAE partnerships and research opportunities. Participant input will help workshop leads identify and publish shared priorities and inform future Carbon to Sea programming.

Indigenous Science Partnerships

KEN PAUL & BROOKE MOORE
POKIOK ASSOCIATES, CANADA

Overview

Indigenous Peoples have long led rigorous, place-based scientific inquiry grounded in observation, stewardship, and intergenerational knowledge transfer. Across Canada, Indigenous-led research initiatives are advancing environmental monitoring, fisheries science, coastal stewardship, and climate adaptation, often in parallel with, and complementary to, academic and industrial R&D. Despite growing recognition of Indigenous Knowledge systems, there remain few venues that meaningfully platform Indigenous-led science as science, center Indigenous researchers as equal partners, and create space for reciprocal collaboration with international academic and private-sector scientists.

This workshop highlighted Indigenous-led scientific projects in Canada and Two-Eyed Seeing, a guiding approach provided by Mi'kmaw Elder Dr. Albert Marshall, which encourages learning from one eye with the strengths of Indigenous knowledge systems, and from the other eye with the strengths of Western knowledge systems, while using both together for the benefit of all.

Participants explored what meaningful partnership should look like when emerging ocean and climate research intersects with Indigenous rights, responsibilities, science, advisory work, and community priorities. Through panel reflections and facilitated Who / What / How table conversations, the session focused on who should be involved, what supports are needed, and how partnerships can be designed and carried out in respectful, practical, and meaningful ways.

Outcomes

The themes below summarize topics and perspectives that emerged from the workshop and are intended to support continued learning, reporting, and future conversations with Indigenous Nations, organizations, and practitioners.

Early and Ongoing Involvement: A strong theme was the need for Indigenous Nations, communities, organizations, and rights holders to be meaningfully involved before key decisions are made. Early and ongoing involvement creates space for Indigenous partners to shape research priorities, project design, timelines, decision-making processes, and expectations from the

outset, rather than being asked to respond after the direction of the work has already been set.

Trust, Time, and Relationship-Building: The conversations reinforced that good-faith partnership depends on trust, time, and relationship-building. Meaningful relationships require consistency, patience, and appropriate timelines that allow for proper dialogue, understanding, and decision-making. This is especially important when work involves communities, rights, responsibilities, and knowledge systems, where relationships often need to come before outcomes.

Community Priorities and Realities: Partnerships should be shaped by community priorities, governance processes, and lived realities, not only by external research, funder, or industry timelines. This requires involving the right partners early, including Indigenous rights holders, Indigenous-led organizations such as Aboriginal Aquatic Resource and Oceans Management programs (AAROMs), community knowledge holders, ocean users, institutional and sector partners, and others connected to ocean work. Clear consent processes, two-way information-sharing, meaningful follow-up, and research design developed with communities are essential components to ensuring the work is respectful, relevant, and useful.

Capacity, Resources, and Practical Support: Meaningful participation requires practical support. This includes sustained funding, dedicated funds within research applications, mentorship, liaison roles, translation support, and investments that strengthen community and organizational capacity. Properly resourcing partnership helps ensure participation does not create additional burdens for communities, Indigenous organizations, or Knowledge Holders who are already carrying multiple responsibilities.

Communication, Transparency, and Follow-Through: Clear communication and follow-through were central to how partnership should happen in practice. Open and honest communication, clear purpose and process, defined roles and timelines, meaningful updates, and accountability all help to build trust and reduce uncertainty. These elements also help clarify who is involved, what decisions are being made, how knowledge or input will be used, and what happens after engagement takes place.

Consent, Indigenous Knowledge, and Data Sovereignty: Respectful partnership requires clear expectations around consent, Indigenous Knowledge Systems, and data sovereignty. The conversations reflected the importance of Two-Eyed Seeing; Ownership, Control, Access, and Possession (OCAP); Findable, Accessible, Interoperable, and Reusable (FAIR) and Collective Benefit, Authority to Control, Responsibility, and Ethics (CARE) principles; Knowledge Holder ownership and permissions, informed consent, community consent; and avoiding knowledge extraction. These points underscore that Indigenous Knowledge Systems are not simply information to be collected, but knowledge held within specific relationships, responsibilities, permissions, and governance contexts.

Next Steps

Pokiok Associates will work with Carbon to Sea to integrate the reflections from the Indigenous Science Partnerships workshop into future publications and other public materials, to inform future conversations about Indigenous engagement, partnership, and participation in the OAE and oCDR space.

Perspectives on Measurement Requirements for MRV

DR. DARIIA ATAMANCHUK
DALHOUSIE UNIVERSITY, CANADA

Overview

Measurements and observations inform model development and validation, and are vital in establishing environmental baselines and detecting perturbations. As such, measurements constitute the key component of any credible MRV framework that aims at 1) assessing the additionality of CDR, 2) assuring that regulatory compliance is met, or 3) sustaining public trust in CDR methods through providing empirical evidence. The types of measurements, their resolution, accuracy, and precision strongly depend on the purpose of the data being collected; hence, the knowledge of the data needs appears fragmented and incoherent at times.

This workshop aimed to enhance community-wide understanding of the role of measurements in MRV and align on priorities, gaps, and opportunities. Participants engaged in pre- and post-workshop polling across six focal MRV categories: Research, Regional Modeling, Global Perspectives, Technology and Metrology, Operational and Compliance, and Data Availability and Management. Subject matter experts provided lightning talks on each topic and were assigned to a table alongside one or two other experts. Participants then moved between MRV expert tables to engage with the experts on each MRV category for 10 minutes, using a scorecard with guiding questions and space to document their impressions. The workshop concluded with a brief reflection on the themes most frequently raised, followed by the post-workshop poll.

Outcomes

Post-workshop polling, analysis of the scorecards, and feedback from the table leads revealed an emerging convergence on MRV priorities and a shared understanding of critical gaps. Notable and often raised issues in the collected feedback were:

Importance of characterization of feedstock transport and reactions in situ. Feedstock-related processes are sometimes poorly defined, and there is a need for more effective sensors and analytical techniques to capture feedstock characteristics and changes.

Emphasis on the near-field and local scale, but in strong connection with regional and broader-scale observations. Local conditions,

discharge activities, industrial impacts, and other site characteristics can strongly influence measurements. Participants saw value in local observations for understanding these effects and improving attribution, and emphasized the need for a multi-scale observing strategy with robust global coverage, stronger observations in underrepresented regions, and better connections between local measurements and global assessments.

Importance of data frequency and quality, including in the verification and validation of biogeochemical models. Participants realized the critical role of frequently measured, high-quality data. For example, one noted the need for better distribution and interpretation of frequently measured data, highlighting that data frequency and reliability are often underestimated in MRV systems. Participants specifically noted that a lack of quality measurements makes it difficult to validate regional and biogeochemical models.

Technical accessibility vs. overall usability and cost. There was an "aha moment" around the gap between what technology can measure and what is actually needed for MRV. Participants recognized that technological advances do not always translate into practical, field-ready solutions. The distinction between technical accessibility (can the data be technically accessed?) and overall usability (is the data actually useful for decision-making?) was made.

Potential of public data. Some participants were surprised by the potential for fully public data to be used for research and operational purposes, raising questions about how to access and utilize such data effectively.

Operational realities and compliance. There was a realization that poor data quality or lack of clarity in operational data can significantly hinder compliance and impact assessments.

Need for standardization and collaboration. Participants noted the importance of standardizing data and collaborating across sectors and disciplines to improve MRV outcomes.

Awareness of unknowns and uncertainties. Some participants expressed surprise at the extent of unknowns and uncertainties in current measurement approaches, especially regarding data gaps and the need for better-defined baselines.

The workshop highlighted the value of integrating diverse perspectives (e.g., research, technology, compliance, data availability) to identify blind spots and new opportunities. The participants noted that they became more informed about the measurement needs among the categories, confirming that such educational and level-setting exercises are an effective approach to identify research priorities and gaps.

Next Steps

Atamanchuk will further evaluate workshop feedback materials to reveal the full spectrum of participants' impressions and take-home messages. Atamanchuk plans to publish a brief detailing the measurement priorities with community-wide consensus and recommend approaches to address them.

Learnings from Coastal Integrations for Open-Ocean Climate Solutions

DR. GABRIELLA KITCH & ANU KHAN
CARBON REMOVAL STANDARDS INITIATIVE, USA

Overview

To address uncertainty around OAE's environmental impact, permitting, and social license, many OAE field pilots are integrated into existing coastal and industrial systems. By leveraging existing infrastructure, expertise, and regulatory pathways, researchers are better equipped to answer these key questions and build upon the available body of field data. However, the field lacks a clear framework for assessing how insights from these integrations translate to large-scale implementation.

This workshop brought together OAE researchers, practitioners, and invested community members to explore what the field can learn from three integrated OAE projects: desalination paired with electrochemical OAE (introduced by Dr. Mallory Ringham, Ebb Carbon), wastewater treatment paired with mineral OAE (introduced by Joachim Katchinoff, CREW Carbon), and coastal habitat restoration paired with accelerated weathering of limestone (introduced by Dr. Lennart Bach, University of Tasmania).

Participants worked in eight breakout groups to generate research questions for MRV, environmental considerations, social considerations, scaling, and efficacy, then sorted these questions by knowledge transferability, thereby determining whether the questions are facility-specific, applicable to comparable facilities, or broadly applicable to standalone deployments.

Outcomes

The workshop surfaced substantive research questions and strategic insights from integrations across all of the major categories. The major takeaways from each are:

MRV: Modeling on air-sea gas exchange (relative amounts of ingassing or prevented outgassing) from an OAE integration is highly transferable knowledge across facilities.

Environmental considerations: Different organisms, stressors, and baselines across locations make transferring site-specific

studies to the larger field difficult, but studying responses across dilution gradients and prioritizing well-characterized sites can accelerate mechanistic understanding when repeated.

Social considerations: Fishing community participants emphasized the need to quantify co-benefits locally, distinguish clearly between pilots and credit-scale projects, and meet communities around interests (e.g., jobs, water quality, and fisheries health) rather than framing solely around global climate both within and beyond facility-specific integrations.

Scaling: Participants found that research questions about energy use, feedstock availability, and life-cycle analyses could be utilized for other facility integrations and more general applicability.

Efficacy: Secondary precipitation thresholds emerged as a major theme for transferability from coastal integrations where dissolution rates in chemically complex facility environments will benefit the overall OAE field.

Participants broadly agreed that learnings transferable to standalone deployments need to be deliberately designed into integrated projects rather than assumed to emerge on their own.

Next Steps

Kitch and Khan will use the research questions and discussion themes from this workshop as primary inputs for a peer-reviewed perspective on how to maximize transferability of integrated OAE solutions. The publication will consider how integrated projects can provide insight into large-scale implementation of OAE, with advanced planning and consideration of transferable research outcomes.

A Path to Success: Expert Input on R&D Roadmapping

DR. DAVID KELLER & LAURA STIEGHORST
CARBON TO SEA, USA

Overview

An OAE research roadmap can help streamline R&D activities to support science-informed policy decisions in the next decade. This workshop gathered community-wide evaluation of research priorities in preparation for such a roadmap.

Participants were grouped by OAE pathway and asked to prioritize eight research topics from 42 prescribed topics. They then evaluated and justified the level of uncertainty and resolvability of each topic and sequenced the topics over a relevant timeframe. The workshop produced rudimentary roadmaps for addressing the highest-priority topics for each OAE pathway.

Outcome

Altogether, participants selected 26 of the initial 42 topics to prioritize, including 13 of the 22 topics related to environmental safety, 8 of the 14 topics on efficiency, and 5 out of 6 topics on MRV. An additional 20 new topics were proposed.

Based on their associated uncertainty and resolvability, the 46 topics prioritized by participants were categorized into topic 'archetypes.' These include:

Foundational Priorities (20 percent of all priority topics). These include mission-critical topics with a challenging road ahead. Across all of the OAE pathway scenarios, participants most often prioritized the following three topics:

- establish local/regional baselines for OAE activities;
- quantify air-sea gas exchange dynamics
- develop oceanographic models and guidelines for their use during MRV.

These topics are highly interdependent and collectively address the question of whether CO_2 uptake in the ocean can be measured and modeled against baseline conditions. All three were scored as having "medium uncertainty" and "medium-high resolvability," with participants citing site-specific complexities and lack of data and resources as blockers for resolvability. Keller and Stieghorst grouped these topics as "Foundational Priorities," because they are topics that must be resolved across all contexts and scales of OAE.

Near-term Opportunities (19 percent of all priority topics). These research topics were categorized as having "low-medium uncertainty" and "high-medium resolvability," and were therefore considered resolvable with some time, money, and effort. The topics revolved around technological, supply chain, and social developments, including electrochemical membrane development, techno-economic analysis, understanding the legal landscape around permitting, and identifying synergies and value-adding co-products.

Complex Challenges (7 percent of all priority topics). These topics were categorized as having "high uncertainty" and "low resolvability," representing the most challenging topics in the evaluation. These topics captured complex biological processes such as trophic mismatching, and the impacts of OAE-induced changes in seawater carbonate chemistry on food web dynamics and ecosystem processes. These topics depend heavily on foundational knowledge of food webs; ecosystem processes and changes to organism behavior; and physiology as a result of carbonate chemistry change. These biological systems are often hard to measure and very difficult to study in a lab setting. Resolvability will require innovative experimental design, field research, and dedicated multi-year programs.

High-potential Opportunities (51 percent of priority topics). These topics were categorized as having "medium-high uncertainty" and "medium-high resolvability," representing some very compelling research challenges. Commonly selected topics in this category include: impacts of OAE on pelagic macro- and mega-fauna (e.g., fish and invertebrates), reversibility of OAE impacts, impact of OAE on nutrient and other biogeochemical cycles, and quantification of water column mineral precipitation thresholds and triggers. These topics are somewhat interdependent, with potential for significant leaps in progress if resolved, but currently held back by a lack of data and process understanding. Their blockers are diverse and often specific to the OAE pathway. Progress will require innovative research design and coordination.

Next Steps

Keller and Stieghorst will use the workshop materials to develop an OAE research roadmap that will directly inform Carbon to Sea's grant-making strategy. The topic archetypes that were identified provide a framework to assess topic readiness for resolvability and timelines for investment. Participants should expect to see their input reflected in the strategic direction of Carbon to Sea's R&D program and future funding opportunities.

Lessons from Early Community and Policy Engagement

DR. CELINA SCOTT-BUECHLER
DUKE UNIVERSITY, USA

Overview

Ocean-based CDR has quickly gone from something that primarily exists in models and wet labs to field projects that interact with social and governance systems. Responsible deployment requires meaningful engagement with local communities, Indigenous governments, the broader public, and policymakers at local, regional, national, and international levels. Researchers, technology developers, and policymakers themselves now have several years of experience experimenting with different methods of community and policy engagement on oCDR—with mixed results. What have we learned? How can successes be replicated and missteps avoided?

This workshop invited anyone involved in these early experiences in engagement, personally, organizationally, or through observations of the broader field, to share what they learned and to learn from others. The discussion aimed to move beyond high-level guidance and develop actionable, experience-based practices and guardrails for oCDR engagement.

Outcome

With 50 participants across 10 breakout groups, discussions were rich with diverse perspectives on what the field has learned. Discussions covered both how to "engage" (on individual oCDR projects and on oCDR as a whole), as well as what it would look like to "be engaged." In the second paradigm, communities, rights-holders, and interest-holders would identify their own priorities for oCDR as part of broader marine management systems and proceed to identify and reach out to researchers and/or developers, rather than the other way around.

Across these paradigms, the need to co-develop projects (from research through deployment) was underscored. Themes that fell under this umbrella included:

Transparency is necessary for building trust. This requires openly sharing information about research activities, goals, and uncertainties with parties including local communities, resource management experts (such as those in the fishing sector), and regulators.

Engagement must be early, frequent, and iterative. While there were differing interpretations of what each of these mandates ("early," "frequent," and "iterative") entailed in practice, there was broad recognition that engagement with communities, regulators, interest-holders, and rights-holders could not be relegated to one-off outreach.

oCDR is difficult to communicate and requires strategies to do so effectively. Participants from different backgrounds recognized that oCDR, broadly, and OAE more specifically, are conceptually challenging for those who are first encountering them. The jargon and acronyms, while useful in some settings, can create feelings of inaccessibility in others. Figuring out how to effectively communicate the core concepts, along with their goals and uncertainties (and the range of those uncertainties), is an ongoing effort in the field.

The field's expertise base needs to be broadened. Expert knowledge from First Nations and Indigenous communities, the fishing industry, the social sciences, and local publics with local ecological knowledge remains largely absent from the production of OAE science; including these sets of expertise presents opportunities to increase rigor and application-awareness of results.

Next Steps

In alignment with the topline theme of co-development, results of the workshop will be co-interpreted with participants, especially First Nations and Indigenous community delegates. In alignment with the sub-themes identified, decisions on how to position the workshop as a starting place (rather than a one-off) for transparent, iterative, accessible, and plural knowledge production will be made jointly.

Assessing Environmental Risk of oCDR Projects with FEMM

DR. GRACE ANDREWS
HOURGLASS CLIMATE, USA

Overview

As oCDR projects move from field trials toward commercial-scale deployment, the industry faces a critical challenge: how to rigorously, consistently, and quantitatively evaluate environmental safety in the ocean. This hands-on workshop provided a concept-level overview of the Framework for Ecotoxicological Modeling of mCDR (FEMM) (see Andrews' presentation summary for more detail), a structured approach for conducting environmental risk assessments of oCDR projects. FEMM is grounded in established regulatory risk assessment practices from ecotoxicology and adapts these approaches to the unique challenges posed by oCDR, including OAE. The workshop also included a hands-on trial of FEMMtool, a web application currently in development by Hourglass, that allows for the practical implementation of the FEMM guidance and completion of ecotoxicological risk assessments.

Participants from across the OAE industry, including project developers, regulators, and academics, tested the FEMMtool and provided feedback for future improvements.

Outcome

Participants completed four FEMMtool modules that provided an illustration of their varied applications. For example, FEMMtool was used to compare the environmental risk of two hypothetical OAE project sites and demonstrate how users could apply it for responsible project planning. It was also used to evaluate the environmental impact of an OAE project using uploaded monitoring data and, in turn, demonstrate how users could apply FEMMtool to ensure their project site was operating safely.

Feedback from the workshop indicated that 84 percent of participants left with a strong grasp of the FEMM guidance, and 72 percent of participants found FEMMtool intuitive and easy to use. Most importantly, 89 percent of participants stated that if the environmental stressor(s) relevant for their OAE projects were available in FEMMtool, they would be likely to use it, demonstrating a strong industry desire for rigorous environmental risk assessment.

Participants also provided constructive feedback on additional functions they would like to see in FEMMtool, such as the ability to calculate metrics specific to highly degraded or protected environments. They also suggested other features such as the ability to include their own ecotoxicological data or generate folders where multiple collaborators on a project could jointly log in.

In general, participants walked away with the understanding that for OAE-relevant metals (e.g., nickel), there is already sufficient existing ecotoxicological data for FEMMtool, but that expanding its scope to carbonate chemistry stressors will require a significant increase in testing that follows standardized methodologies such that the data can be used in statistical models (e.g., with multiple timepoints or without covarying stressors, etc.).

Next Steps

Following the workshop, Hourglass will be launching a campaign to collect existing carbonate chemistry ecotoxicological datasets that are not yet publicly available or hard to find, and will launch FEMMtool v1.0 in Q3 2026, implementing many of the workshop participant suggestions.

Site Visit: Halifax

Halifax is a fast-growing hub for ocean-climate research, with several academic institutions, private-sector companies, and government leaders advancing OAE R&D. Attendees at these site visits, held a day before the presentations started, were able to see research in action at the world's longest-running OAE field trial by visiting Dalhousie University and Planetary field operations. The visits provided attendees with a unique, firsthand look at how research, monitoring, and deployment are being conducted in practice.

Site Visit: Dalhousie University

At Dalhousie University, participants toured OAE and ocean-climate laboratories and heard directly from the researchers leading this work, including Dr. Chuck MacDonald, Dr. Graham Gagnon, Dr. Shannon Sterling, Dr. Julie LaRoche, Dr. Erin Bertrand, Emily Chua, David Burns, Richard Cheel, Dr. Doug Wallace, and John Batt. Attendees asked questions and engaged in discussion on how the university's lab infrastructure and research programs support OAE R&D and ocean-climate goals.

Site Visit: Planetary's active OAE operation

The tours also included a visit to Planetary's active OAE operation co-located at Nova Scotia Power in Tufts Cove. Planetary's Chief Executive Officer, Mike Kelland, and other staffers demonstrated the technology used to deliver alkalinity into Tufts Cove, how they integrated into an existing outfall at the site, and how they make measurements.

For More Information:

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