



OCEAN VISIONS

Advancing Solutions for Ocean-Climate Restoration

April 23, 2024

Dear Members of the Marine Carbon Dioxide Removal Fast-Track Action Committee (MCDR–FTAC),

We write our responses below on behalf of Ocean Visions and in consultation with our collaborative network made up of universities and oceanographic institutions, and a diverse set of practitioner partners -- the [Ocean Visions Network](#). Network institutions include scientists, researchers, environmentalists, policy professionals and others who are working to better understand the potential contributions, efficacy, and environmental impacts of marine CDR (mCDR) approaches and to advance the needed research and development within effective governance mechanisms.

1. Impact of the mCDR Plan on Ocean Visions and the Ocean Visions Network

A comprehensive and appropriately funded mCDR plan would provide an overarching framework and the resources needed for a suite of research, development, and demonstration (RD&D) activities that are needed to determine the efficacy of mCDR technologies as potentially safe and effective climate solutions.

This program of RD&D would engage the resources of our broader community of science, academia, philanthropy, civil society and industry, among others, allowing us to expand current programs and create new ones to accelerate the knowledge and understanding of the efficacy, ecosystem impacts, and scalability of mCDR approaches.

2a. Questions and Concerns about the Regulation of mCDR, including mCDR research

Our concerns center on the lack of an overarching plan to advance needed mCDR RD&D and a specific enabling regulatory framework for the needed RD&D in this arena. Determining how mCDR can contribute to needed global CDR targets is in the national interest, and the US government will need to act to enable the RD&D. Currently, the processes and time needed to get permits to complete mCDR RD&D are unclear, slow, and can add years to what should be an urgent experimental process.

In particular, the federal government must speed up the permitting of well-designed field trials which answer the following [questions outlined here](#):

- Does the mCDR activity generate a measurable reduction in seawater carbon dioxide concentration?
- Can net additional ocean uptake of atmospheric carbon dioxide be tracked in response to the mCDR activity using a combination of sensors, platforms, and models?
- What are the impacts to marine ecosystems of mCDR activities and are they acceptable when compared with the impacts of the no-action alternative or of other feasible mitigation measures?
- What are the range of impacts to human populations and are they acceptable when compared with the impacts of the no-action alternative or of other feasible mitigation measures?

In addition to streamlining authorization for research, permits should mandate transparency and rapid public access to information on the design, performance, and results of trials.

2b. Tools or resources that the federal government should provide to support mCDR research

Some of the tools the USG could provide to support the safety and effectiveness of research include:

- Creation of pre-permitted test beds in areas under federal jurisdiction (drawing on a [concept](#) already in use by the US Navy and Department of Energy for marine renewable energy).
- Technical support for permit seekers to speed up the process.
- Access to labs, ships, and other infrastructure through public-private partnerships.

- Easy access to fit-for-purpose marine spatial planning and suitability analysis tools.

The USG should also lay out the minimum acceptable standards for research design. Research designs should encourage close coordination with other sectors and stakeholders, ideally in the form of public-private partnerships (like the recently [announced call](#) by the US Department of Energy).

2c. Current Knowledge to inform the safe and effective regulation of mCDR research

- Research agendas exist for some pathways that outline the full body of evidence needed to inform safe and effective research. These include research plans with budgets for 6 pathways in the [NASEM report](#). The [Ocean Visions macroalgae research framework](#) and the ExOIS [Path Forward report](#) outline the steps needed to move from research to deployment for macroalgae sequestration and sinking and ocean iron fertilization respectively.
- Early ocean alkalinity enhancement experiments have shown that positive environmental outcomes are possible from permitted OAE field trials done with the proper environmental safeguards. See examples [here](#), [here](#) and [here](#).
- Several modeling studies on the potential for mCDR, including these studies [here](#) and [here](#), provide insights into optimal locations for mCDR research.
- A rapidly growing literature on the environmental impacts, especially for OAE, including [this recent paper provides current knowledge of safe operating boundaries](#).
- [13 ocean iron fertilization field trials in the 1990s/2000s provide a base for further research and demonstrate that field trials did have not long-term environmental impact to the marine environment](#).
- Suitability analysis tools developed to identify the sites best positioned to support research on [ocean iron fertilization](#) and [seaweed farming](#) based on pre-defined criteria including safety and effectiveness.
- Studies of natural analogs including [these projects](#), and [this](#) paper can be used to provide support for larger scale field trials utilizing the underlying mCDR approach.
- Social Science research that provides a framework for socially responsible early research including [this recent paper](#).
- Syntheses of legal frameworks, including [this one](#) to advance safe and effective mCDR research in the United States.

Additional Knowledge Needed

Several tools and additional knowledge will help especially to make permitting of field trials faster. These include:

- Developing research designs for remaining pathways that lay out the minimum number of experiments and all design details to produce acceptable empirical evidence to make sound policy decisions for full scale deployment and commercial application. Ocean Visions and the Carbon to Sea Initiative will create such a research design for ocean alkalinity enhancement pathways in 2024.
- Guidelines on building clear, pre-registered hypotheses about additionality, durability, and environmental side effects and a publicly available repository to store these hypotheses for later referencing as field trials are completed and results become available.
- Well-vetted and agreed upon environmental thresholds that research must not surpass.
- Additional suitability analysis tools to identify the sites best positioned to support research based on pre-defined criteria including safety and effectiveness.
- Tools to do comparative risk analyses that help regulators and stakeholders understand the costs and benefits of doing the research against those of other options, including those of the no action alternative.
- Tools and guidance to perform life cycle assessments (LCA) and technoeconomic analysis (TEA) that are applicable to working in the marine environment.

3a. Aspects of mCDR that the Federal Government should prioritize for research

The Federal government should prioritize for research all solutions that can deliver gigaton-scale CDR with durable storage of CO₂ of 100+ years. This information has been summarized in [Strategy for NOAA Carbon Dioxide Removal Research](#) and National Academies of Sciences, Engineering, and Medicine's [A Research Strategy for Ocean-based Carbon Dioxide Removal and Sequestration](#).

For all the techniques that pass this minimum potential viability criteria, the federal government should support field trials at appropriate scales to determine potential efficacy, environmental and social impacts, and feasibility. Once further data is available from field trials, priorities can be re-set to focus on those techniques that continue to be viable with acceptable impacts.

3b. Promising mCDR approaches with regard to mitigation, ocean acidification and other benefits

Any mCDR activities concentrated in a limited area will likely provide localized mitigation of ocean acidification. While these effects may be limited, they may provide valuable acidification mitigation if occurring during times of heightened organism sensitivity or during extreme acidification events.

3c. mCDR approaches that are more or less risky

We believe that more research is needed to assess the comparative risk of these approaches when it comes to the environment, public health, and other uses. [Some lower-durability, lower-scalability approaches such as the restoration of mangroves, seagrasses, and salt marshes offer well-documented benefits to human and ecosystem health, with limited risk of side effects.](#)

4a. Information about mCDR most helpful for the Federal Government to make available

Providing information helpful to communities in assessing the benefits and risks of siting specific projects in their community—such as workforce impacts/workforce development and ecosystem impacts (potential benefits and harms) would be useful. This could be done through access to impartial experts, community workshops and training sessions which explain mCDR, and online decision-making tools.

The research community would benefit from access to clear information on funding opportunities and to all research information in the public domain. The government can also create templates, best practices documents, and case studies for others to follow in areas such as scientific research and scientific engagement.

4b. Government engagement with mCDR stakeholders and the public

When locations are identified for potential mCDR projects, it is important to engage with communities early, both to provide information to address their questions and concerns and to consider and address their thoughts and recommendations. Governments should consider co-designing mCDR experiments incorporating local knowledge into experimental design and monitoring and verification. With Indigenous communities it is critical to ensure that their sovereignty and decision-making authority is honored.

5a. Most significant mCDR efforts

NGOs:

- Ocean Visions has a number of knowledge products and tools such as the white paper titled [“A Comprehensive Program to “Prove or Disprove” Marine Carbon Dioxide Removal Technologies by 2030, the mCDR field trial database, Road Maps and the Ocean Iron Fertilization Site Suitability Tool to help a wide range of stakeholders make informed decisions.](#)
- [The World Resources Institute’s report proposes an overall approach centered on informed and responsible development and deployment of ocean CDR.](#)
- [Ocean Conservancy has a number of knowledge products including the perspectives and concerns of different groups currently or imminently involved in mCDR in the US.](#)
- The Aspen Institute has developed [a code of conduct](#) for mCDR research
- The American Geophysical Union (AGU), in partnership with scientific and policy stakeholders around the globe, is developing an [Ethical Framework](#) for Climate Intervention Research, which includes mCDR.
- [\[C\] Worthy](#) is building oceanographic modeling tools to ensure safe, effective mCDR.

- Hourglass Climate plans to conduct independent research into mineral-based Ocean Alkalinity Enhancement strategies to facilitate responsible scale of CDR and climate mitigation.

Academia/Research Institutions:

- [Woods Hole Oceanographic Institution](#) is developing a large-scale, high-resolution network of technologies to track carbon as it moves between the atmosphere and the ocean called the [Ocean Vital Signs Network](#).
- The [Ocean Frontier Institute](#) is developing the [North Atlantic Carbon Observatory](#) to connect and enhance ocean observation and modelling efforts to allow for more accurate measurements of the ocean's ability to absorb and store carbon.
- [Ocean Networks Canada](#) ran a first-of-its-kind experiment in Canada testing the impact of [Running Tide's](#) wood and mycelium buoys and samples of kelp substrate on deep sea environments.
- Stanford University's Doerr School of Sustainability has launched the [GHG-R Flagship program](#) with the first step being to select 16 projects (including mCDR projects) for focused accelerator support.
- The Sabin Center for Climate Change Law at Columbia University has outlined a [series of recommended actions](#) that federal agencies could take, under existing law, to ensure safe and responsible permitting and regulation of ocean carbon dioxide removal (CDR) research in U.S. waters.
- [MIT Environmental Dynamics Lab](#) and [Scripps Institution of Oceanography at UC San Diego](#) are working with [Captura](#) to track and model the plume of CO₂-depleted seawater released from Direct Ocean Capture plants.
- The [Iglesias-Rodriguez Lab](#) at UC Santa Barbara has an active program assessing the impact of Ocean Alkalinity Enhancement methods on the functioning and health of marine ecosystems.
- The [Monterey Bay Aquarium Research Institute](#) has developed a broad suite of sensors, platforms, software and methods to measure, track, and characterize the biogeochemistry of ocean waters and the biology & biodiversity of marine communities; such technologies are essential for mCDR MRV.

Philanthropy:

- The Carbon to Sea initiative is a philanthropically funded initiative that has raised over [\\$50M](#) to evaluate whether ocean alkalinity enhancement can safely remove and store billions of tons of CO₂. They have already disbursed over \$25M to [grantees](#), including Ocean Visions Network organizations.
- The Ocean Resilience and Climate Alliance is a recently announced philanthropic initiative to provide more than \$250 million dollars in grants over four years to catalyze work across a handful of immediate ocean-climate priorities, including in mCDR.

Industry:

- There are several initiatives led by startups. Examples of existing field trials that are led by these startups in the US and elsewhere can be found [here](#). Ocean Visions, with the support of advisors from Ocean Visions Network organizations provides scientific and technical advice to a number of these startups through the [Launchpad program](#).
- The Circular Carbon Network's 2023 [market report](#) identified 74 companies that have identified themselves as ocean focused CDR companies.

Other governments:

- The EU has funded two [research projects](#) that evaluate mCDR from a number of perspectives (technical, economic, legal, social etc.).
- The German government has funded a [similar project](#) that looks at mCDR from a German perspective.

Other Initiatives:

- Under the framework of the UN Decade of Ocean Science, there are Centers that address ocean-climate solutions such as the [Ocean Visions – UN Decade Collaborative Center for Ocean-Climate Solutions](#) and the [Global-ONCE program](#), with Xiamen University in China as the lead institution.

5b. Factors to take into account when considering potential partnerships

Some of the factors that the Federal Government should consider include:

- **Additionality:** would a partnership enable projects to happen that otherwise wouldn't have happened as well as people to participate that would otherwise not have the opportunity.
- **Mission Alignment:** The objectives and goals of the partnering entities should align with those of the Federal Government.
- **Differentiated strengths** that the entity brings to the partnership (this could be technical skills, additional funding, place-based relationships etc.)
- **Capacity to provide the necessary services.**
- **Opportunities to realize scale:** For climate impact, these technologies will need to scale to a global level. While partnering with international entities, it is important to keep this goal in mind.
- **Potential Risk:** The Federal Government should assess all partners for potential risk (reputational risk, financial risk, operational risk etc.) and develop strategies for risk mitigation.
- **Equity:** The selection of partners should be transparent and equitable. Once partnerships are formed, it's important that the benefits and burdens are distributed equitably among all parties involved.

5c. Biggest Challenges in Collaboration and how the Federal Government should address them

- **Consistency of strategy and funding over a length of time:** These issues could be addressed by ensuring that the mCDR plan is funded for 10 years, which is the recommendation of the NASEM report.
- **Clear understanding of strategy, transparency in decision making:** This can be addressed by having a clear outline of strategy before and at the time of developing a partnership agreement and constant communication during the projects to ensure that there's visibility into decision making.

5d. Examples of partnerships most relevant to mCDR partnerships

- Access to national labs to academic, industry and other partners to run lab studies and field trials, building upon [partnerships](#) such as the one between [PNNL](#) and [Ebb Carbon](#).
- Expanding funding for large scale multi-partner research investments such as the [NOPP](#) and [ARPA-E SEA-CO2](#) programs which improves cross-sector collaboration.

6. Other things for the Federal Government to consider as it develops a mCDR Plan?

- It is critically important for the Federal Government to create a MCDR plan that generates all needed information about which mCDR pathways, if any, can be scaled as deployable, effective, and safe part of the national portfolio of climate solutions
- The USG can play an important role in creation of MRV frameworks and tools by developing quality standards, either as a standard setter or as a major procurer of mCDR.
- The USG should develop/fund high priority social science research efforts to address social issues and barriers to mCDR RD&D.
- Interagency coordination and coordination across levels of government will be critical to advancing a comprehensive RD&D agenda.

In conclusion, Ocean Visions appreciates the opportunity to submit this input for your consideration and looks forward to the speedy development of the Federal mCDR plan.

Yours Sincerely,



Brad Ack,
CEO, Ocean Visions