Carbon to Sea Initiative

April 23, 2024

Input to U.S. Marine Carbon Dioxide Removal Research Plan

The Carbon to Sea Initiative (CTS) is a nonprofit effort whose mission is to systematically assess the conditions under which ocean alkalinity enhancement (OAE) can deliver safe, cost-effective, and permanent CO_2 removal at scale. We are guided by a set of core principles that emphasize transparent outcomes, strong and clear governance standards, and sincere stakeholder engagement.

We are delivering on our mission by funding research to close knowledge gaps; advancing relevant technology and policy development; and engaging in community-building to support the emergence of a responsible and sustainable ocean-based CDR sector, should that be appropriate. **Last year, we awarded more than $23 million to scientists and engineering teams** to ask and answer open questions associated with: measurability, efficacy and permanence, environmental safety, economics, utility of byproducts, monitoring, alkalinity delivery, alkalinity generation, and measurement, reporting and verification (MRV).

We greatly appreciate the Administration's establishment of the Fast Track Action Committee to facilitate and advance relevant policy and research on marine CDR (mCDR), and offer the following responses to the questions you posed in the Notice of Request for Information issued on February 23, 2024.

1. How would a Marine CDR Plan affect you, your organization, or your community?

Private investors and philanthropies are stepping up to advance promising mCDR technologies, but those investments will not be sufficient to determine whether and which mCDR approaches can safely and permanently reduce atmospheric CO_2 and do so at the scale that is needed. A well-structured and appropriately funded federal plan for research, development, and demonstration (RD&D) of mCDR is needed to:

- Identify environmental and social considerations that need to be assessed and addressed before mCDR can be deployed at a large scale,
- Signal to private investors that the federal government will be a substantial and committed partner in advancing the technological readiness of safe and effective pathways,
- Clarify permitting of field research and demonstrations to evaluate environmental safety and the potential for net-negative emissions of various approaches, and
- Provide knowledge needed to inform regulatory processes.

2. What questions or concerns do you have about the regulation of marine CDR, including marine CDR research?

We are encouraged by the recent guidance on mCDR permitting issued by EPA and were further encouraged to learn that the USACE recently permitted a project led by Vesta. There

are many great signs that mCDR research efforts can move forward under existing laws. We're optimistic that responsible research can advance under existing authorities. At the same time, we recognize that current laws were not created with ocean-based carbon removal approaches in mind, especially given these projects are intended to generate a net positive environmental benefit.

We encourage the FTAC to assess what regulatory or statutory changes will be needed to permit safe and timely field research of mCDR technologies. Consistent with the President's Ocean Climate Action Plan and the FTAC Charter, the Committee's regulatory review should also include consideration of changes that may be required to eventually evaluate and permit large projects.

Since regulated impacts are largely a function of scale, not the intent of a project, it seems counterproductive to draw a sharp distinction between research and commercial activity when considering changes in the regulatory regime. Properly structured public-private partnerships can share the burden in financing innovation by bringing the combined expertise and resources of the research community and the private sector to solve challenging technological problems, like development of negative-emissions technologies. Permitting of mCDR projects should support these goals, subject to protection of the environment and the public interest. Notably, it is already U.S. practice to support research conducted in partnership between academic entities and the private sector, for example at least nine of the NOPP awards involved partnerships among university researchers, commercial enterprises, or private, non-profit research institutions and ARPA-E's mCDR grants involved small and large businesses, national labs, and universities.

Timeliness of decision making is an important factor towards ensuring a supportive regulatory environment which will lead to increased private sector investment and help the United States maintain its global leadership in advancing climate solutions. Finally, for mCDR to contribute to negative emissions on the timeline and at the scale that the Administration envisions in its Carbon Negative Shot, the federal regulatory agencies will need clear direction to prioritize efficient permitting of the field research and monitoring needed to evaluate the additionality, durability, and environmental effects of the various approaches.

2a. What tools or resources should the Federal Government provide to support the safety and effectiveness of marine CDR research, including testing at scale in the field?

Given the number of laws and federal agencies potentially involved, we suggest the creation of a standing interagency working group on mCDR permitting that lives beyond the duration of the FTAC. Its functions should include:

- Issuing integrated guidance to assist project developers in project design and permit application,
- Providing a one-stop initial point of contact for field research site developers,
- Improving communication and ensuring coordination, both among the agencies and between the agencies and project developers, and
- Minimizing, consistent with sound evaluation of impacts, duplication and delay in permitting.

Also, as mentioned above, we appreciate the recently issued guidance from EPA about mCDR permitting under the MPRSA and the Clean Water Act (CWA). Further clarification on certain permitting matters would be helpful, including:

- The conditions under which an mCDR project utilizing an existing wastewater outfall would be able to operate under an existing NPDES permit, require a permit modification, or require a new permit.
- Guidance regarding design and scale factors affecting a determination of whether projects that propose to place matter into ocean waters wholly or partially for the purpose of ocean alkalinity enhancement require permits under section 102 of the MPRSA or section 404 of the Clean Water Act.
- Guidance from the Army Corps of Engineers regarding the materials that may be used in beach renourishment and other coastal restoration projects permitted under the Rivers and Harbors Act that provide a co-benefit of ocean alkalinity enhancement.

In addition to greater clarity on regulation, substantial and consistent federal funding is vital to drive the field forward. FY 23 funding through the National Oceanographic Partnership Program, and DOE's ARPA-E program and the Office of Fossil Energy and Carbon Management (FECM) provides a valuable down payment. Ongoing and increasing support for research and development of this kind is needed. In 2022, the National Academies of Science, Engineering and Medicine called for at least $1.3 billion in spending over 10 years to fully evaluate and determine which mCDR approaches may be ready for deployment at gigaton scale. CTS recently recommended a significant increase in federal funding for FY25 to put the U.S. on track for this level of investment in mCDR.

A wide variety of technologies to deliver mCDR are under development. A growing number of these technologies are at the point where research in the real world is needed to test theory and laboratory results in situ, evaluating how mCDR interacts with ocean physics and the carbon cycle in situ and assessing collateral environmental effects.

A main reason there's significant need for additional federal funding is that philanthropic *and* private sector funding will be insufficient to support early innovation, let alone advancement to commercial viability — should that be appropriate for any given pathway. Long timelines, high-costs and uncertainties largely prevent significant private capital, which could prevent the real-world testing of promising technologies.

Critical knowledge gaps that need to be filled for the safe and effective regulation of mCDR research include:

- The additionality, permanence, and scale potential of carbon removal produced by the various technologies;
- The magnitude and time scale of environmental benefit (in addition to the hoped-for effect of net carbon dioxide removal) or harm caused by the various technologies;
- As for all CDR pathways, life cycle assessments covering all inputs, outputs, and associated processes, to evaluate the additionality and sustainability of the different mCDR pathways; and
- Information and technology needs to ensure regulatory and public confidence in MRV for mCDR so that it can gain not just regulatory approval but also social license to operate in the public ocean.

We anticipate that national accounting of the effects of mCDR will require increased investment in ocean observations, especially building out the global biogeochemical Argo array (BGC-Argo). The biogeochemical data delivered by this array is critical not only to establish environmental and oceanographic baselines against which the effects of mCDR

deployment can be measured, but also to monitor and verify long-term effects of alkalinity and ocean carbon sequestration.

3. Which marine CDR techniques or what aspects of marine CDR do you believe the Federal Government should prioritize for research?

To achieve the levels of carbon removal anticipated to be necessary, at this early stage, it's important to advance the knowledge base of a variety of ocean-based approaches. The National Academies report highlighted that mCDR approaches have different costs, benefits, and risk profiles. Notably, that report made a point to say that there is high scientific confidence that Ocean Alkalinity Enhancement could be an immensely scalable approach and it is plausible that it could become much cheaper than direct air capture, for example.

We urge the program to prioritize allocating significant resources to safety, field research, and stakeholder and community engagement. Across mCDR, the federal government should do more than close knowledge gaps. It has an opportunity to encourage a "race to the top" in terms of best practices by directly incentivizing project developers to pursue the highest levels of safety, environmental stewardship, accountability, community engagement, and maximization of societal benefits.

OAE and other open-system mCDR approaches face challenges with MRV and assessment of the permanence of carbon removal but a federal research plan is uniquely positioned to provide financial support for field trials with highly rigorous MRV to help evaluate environmental safety, quantify CDR, and assess the durability of carbon removals in open ocean systems. A federal research plan is also best positioned to support long-term monitoring at time horizons unlikely for privately funded efforts.

In terms of stakeholder engagement, research teams need support and dedicated resources for best practices. This means ensuring adequate resources are available to bring in external partners, collaborations, host workshops, among other activities to increase public engagement.

4. What kinds of information about marine CDR would be most helpful for the Federal Government to make available to the public, research community, and other stakeholders?

As it becomes available, it will be important for the Federal Government to make as much information as possible available to the public, in forms that are accessible and comprehensible to non-experts, so that individuals and communities can judge for themselves which forms of mCDR are most sustainable and effective. It will also be essential for the federal government to support research and disseminate information about the direct and indirect economic impact of mCDR, especially as some technologies approach deployment at scale. Public access to federal research results will help ensure ocean-based CDR can earn public trust necessary for safe, effective and permanent technologies to operate in the public ocean space.

In preparation for possible large-scale deployment of mCDR, the FTAC should engage the Ocean Policy Committee and the regional ocean partnerships to begin discussion about the use of ocean space for mCDR and how it can best be accommodated while minimizing conflict with other users of ocean space and resources.

4a. How should the government engage marine CDR stakeholders and the public, including Indigenous communities and communities that may be affected by marine CDR?

CTS is encouraged by recent efforts to elucidate stakeholder engagement as outlined by Guide to Best Practices in Ocean Alkalinity Enhancement Research and the Code of Conduct for Marine Carbon Dioxide Removal Research. Both of these resources offer considerable guidance on the nature and extent of stakeholder engagement necessary to earn support for mCDR research.

Given the federal government's experience regulating and supporting new ocean industries, **it would be valuable for federal agencies to share examples of past, productive public engagement for other industries.** In particular, what can we learn about how public engagement efforts generally grow and evolve over time to help ensure we're meeting high standards for public engagement while also ensuring we're setting a vision that's achievable for various scales of field research and allocating the necessary resources.

5. What are the most significant marine CDR efforts being undertaken by academia, industry, philanthropy, non-governmental organizations, and other governments that the Federal Government should be aware of?

Carbon to Sea, a non-profit effort, is the largest private funder of OAE RD&D. In 2023 we awarded more than $23 million to scientists and engineering teams that span 5 countries and include 11 universities and 4 companies. Several of its grantees are also recipients of federal grants, including grantees that have formed cross-sector partnerships, bringing academia and the private sector together. This is the latest example of a well established practice.

From renewable energy, to consumer safety and medical and pharmaceutical advancements, U.S.-based research institutions and business entities have a long and successful track record of partnering for innovation. EPA's own Small Business Innovation Research (SBIR) program supports the development of new science and technology that addresses the EPA's mission to protect human health and the environment, and projects to develop and commercialize technologies to address climate change are a major focus of the program.

We are strongly in favor of doubling down on this approach, in part because it will help the United States to maintain its global leadership in advancing mCDR and other climate-related technologies. Last year's funding for mCDR research reflects this philosophy with grants going to universities, commercial enterprises large and small, and private, non-profit research institutions.

In addition to support for RD&D, it is critical that the U.S. maintain a policy and regulatory environment conducive to advancement of a domestic industry through collaboration between the public and private sectors. U.S. law regulates mCDR based on the potential for environmental impact, which is a function of scale, not the intent of the project. FTAC should ensure that both domestic and international regulatory processes and thresholds encourage public-private collaboration, not establish roadblocks to partnerships advancing these promising technologies to readiness for large-scale deployment.