

November 18, 2022

To Whom It May Concern:

We are pleased to share Ocean Visions' response to the Office of Science and Technology Policy's (OSTP) and Council on Environmental Quality's (CEQ) recent Request For Information regarding the development of a US Ocean Climate Action Plan. We commend the development of an Ocean Climate Action Plan and urge bold action that unlocks the ingenuity, focus, and funding necessary to combat the climate crisis.

In our responses below, questions posed by OSTP and CEQ are shown in ***bold italics with underline*** with Ocean Visions' response beneath. If you have any questions about this response, please do not hesitate to contact us at: info@oceanvisions.org.

Sincerely,

Brad Ack, Executive Director
On behalf of the team at Ocean Visions

Background information. Please briefly describe the role that you/your organization has in ocean-based climate solutions. If relevant, please describe how you/your organization engages with underserved communities.

[Ocean Visions](#) is a US non-profit organization that sits at the center of a [wider network of partners](#). This network is comprised of leading North American universities and oceanographic institutions and a diverse set of practitioner partners who work together to advance research and innovation into scalable solutions to address the interlocking crises in our ocean and climate. Ocean Visions works to engage and focus the resources of our network of partners for concerted action by catalyzing collaboration, co-design, development, testing and evaluation of solutions; and by creating the enabling conditions to advance ocean-based climate solutions.

What ocean-based climate solutions should be considered, and over what time scales?

As part of its action agenda to meet the Paris climate agreements, the United States should support a more comprehensive ocean-based climate solutions agenda of "Reduce, Remove, and Regenerate". We explain this shorthand below.

"Reduce" -- Ocean-based paths to decarbonize our economy:

The ocean has an enormous role to play in carbon-free sources of energy, carbon-free or low carbon sources of animal protein, and in carbon-free sources of transportation. A recent report from the High Level Panel for a Sustainable Ocean Economy suggests that ocean-based pathways could contribute to [nearly 12 gigatons of avoided emissions of CO₂-equivalents, approximately 20% of the reduction in emissions needed to limit global warming to 1.5° C](#) (based on 2019 data). The United States should develop an action agenda to advance:

- Marine renewable energy technologies, including, but not limited to:
 - Offshore wind: [The Biden-Harris Administration is already committed to growing offshore wind to 30 gigawatts by 2030](#)
 - Wave energy, tidal energy, and ocean thermal energy conversion
- Technologies to eliminate the use of fossil fuels to power freight and passenger ships. This is consistent with the [Biden-Harris Administration's work with the International Maritime Organization to reach zero emission from shipping by 2050](#)

- New technologies to monitor, protect, and restore critical coastal marine ecosystems, such as marshes, seagrasses, and mangroves. These technologies include the use of aerial and surface water drones, computer vision, and artificial intelligence among others.
- Expanded use of sustainable aquaculture and mariculture to fulfill nutritional needs and achieve food security
- Reduction in the carbon intensity of beef through [seaweed supplements that decrease enteric methane emissions](#)

Several of these technologies such as offshore wind, expansion of sustainable aquaculture and the use of technologies to monitor and protect critical coastal marine ecosystems are feasible now and the agencies of the federal government should work together to streamline the permitting process.

“Remove” -- Ocean-Based Carbon Dioxide Removal:

Carbon dioxide removal (CDR) at the scale of hundreds-to-thousands of gigatons by the year 2100 is [now recognized](#) as an imperative for climate stabilization. As the largest reservoir of carbon on the planet, the ocean has an enormous role to play in meeting this required carbon dioxide removal and long-term (>100 years) sequestration. It is also vastly under-developed and under-invested relative to terrestrial and technological pathways for carbon dioxide removal.

Last year, the United States National Academies of Sciences, Engineering, and Medicine released [a research agenda to advance the research and development of ocean-based carbon dioxide removal technologies](#). This report follows on earlier reports from the [Energy Futures Initiative](#) and [GESAMP](#). Ocean Visions has built and maintains [living, digital technology road maps](#) that provide assessments of the state of technology, risks and co-benefits, critical obstacles and knowledge gaps, and the biggest priorities needed to move research and development forward. The United States government should develop, fund, and execute a coordinated strategy to accelerate testing of critical technologies in this new area, with the most immediate priority being the enabling and execution of controlled field trials for the different ocean-based CDR technologies.

“Regenerate” -- Regenerating Critical Marine Ecosystems:

Our best collective efforts to date to decarbonize, and our nascent efforts to remove carbon from the atmosphere and ocean, have been woefully insufficient to address the existential threats that climate change poses to Earth’s life support systems. While many are working to increase the pace and scale of decarbonization across all economic sectors, and others to add direct carbon removal into the action plan, the time lag between those actions and cooling the planet will be large. Meanwhile, critical components of the ocean-climate system, such as [Arctic sea ice, coral reefs, and continental ice sheets are at risk of reaching critical levels of loss of function](#) that may lead to rapid and sometimes irreversible changes. Some of these transformations may trigger positive feedback loops that accelerate warming and further damage to other “vital organs” of the ocean-climate system. For each of these critical components of the ocean-climate system at risk of dangerous transformation, there is an urgent need to identify, assess, and evaluate the range of interventions potentially capable of prolonging and/or regenerating the function of these systems systematically and transparently. The US government should develop, fund, and execute a coordinated strategy to assess the efficacy and risks of the potential tools available.

What are specific examples of ocean-based climate mitigation and adaptation activities that the United States should seek to advance?

The United States should advance the following objectives related to ocean-based climate mitigation and adaptation:

- Expanded use of mature marine renewable energy to the US grid
- Expanded research and development into newer forms of marine renewable energy, such as tidal and wave energy, and ocean thermal energy conversion
- Expanded development and demonstration of zero-emissions shipping technologies
- Greater adoption of advanced technologies for remote sensing, monitoring, and protection of coastal vegetated habitats

- Expansion of responsible and sustainable aquaculture and mariculture in US waters
- Development, funding, and support for an ambitious research, development, and demonstration agenda to accelerate the advance of our understanding of ocean-based carbon dioxide removal pathways
- Development of a climate intervention research program to accelerate research on the potential array of tools and interventions that can might be deployable to regenerate critical marine ecosystem at risk of catastrophic change and loss

What kind of research is needed to implement and evaluate the effectiveness and impacts of ocean-based climate solutions?

The United States should support an ambitious research and development agenda, including field testing, to advance our knowledge on all ocean-based carbon dioxide removal pathways. These technologies include:

- Macroalgae (seaweed) cultivation and sequestration
- Ocean nutrient fertilization
- Ocean alkalinity enhancement
- Artificial upwelling and artificial downwelling
- Electrochemical removal of carbon dioxide from seawater (sometimes referred to as “direct ocean capture”)
- Large-scale restoration of open-ocean and coastal marine ecosystems

All ocean-based carbon dioxide removal research activities should focus on answering one or more of the following questions:

- Does this technique provide *additional* uptake of carbon dioxide from the atmosphere and sequester the carbon dioxide from the atmosphere for a minimum of 100 years?
- What are the environmental risks and/or co-benefits of this approach?
- What are the social risks and/or co-benefits of this approach?
- What are the potential synergies with existing industries that can ensure transitions to zero-carbon or carbon negative economies are just?

Case Study: A Framework for Global Research to Answer Critical Questions About Sinking Macroalgae for Carbon Dioxide Removal

Ocean Visions, in partnership with the Monterey Bay Aquarium Research Institute, convened a working group consisting of members across academia, government, and industry to improve the understanding of the effectiveness and consequences of sinking macroalgae to the deep ocean for long-term carbon sequestration. This working group designed a [globally applicable research framework](#) intended to guide the necessary research to answer key questions about the efficacy and impacts of this proposed approach. In total, this report calls for \$1 billion in global research funding. Providing funding for research priorities highlighted in the report provides an immediate means by which the US can position itself as a champion of accelerated research for ocean-climate solutions.

How can Indigenous knowledge be highlighted to inform solutions?

Ocean-based carbon dioxide removal is a nascent field, with potential to develop equitably or inequitably. There is a tremendous opportunity to engage with Native American tribes who might lead in ocean-based carbon removal at an early stage. This helps ensure that knowledge is generated and shared equitably. As an example, Ocean Visions has been working with [Global Ocean Health](#), a non-profit with deep ties to the tribes of the Pacific Northwest, to provide the necessary information and resources to help these tribes consider what role(s) they would like to play in the research and development of ocean-based carbon dioxide removal.

What are important questions, issues, and unknowns that need to be addressed?

- Which solutions have the largest potential to mitigate carbon emissions? These evaluations should include life cycle assessments to understand mitigation potential across a value chain, and technoeconomic assessments to understand barriers and opportunities to scale.

- What are the environmental and social risks of each technology? And what is the risk tolerance for each technology? This requires incorporation of risk-risk tradeoff frameworks into decision making that weigh the costs and benefits of an action against those of both an alternative action as well as a business-as-usual scenario.
- **All ocean-based carbon dioxide removal technologies require additional field testing using controlled field trials. Controlled field trials are the only means to establish cause-effect relationships in real world, complex marine environments. As such, they are a core and irreplaceable component of evaluating proposed ocean-based climate solutions.** For further information on guidance for controlled field trials of one proposed ocean-based climate solution, sinking macroalgae for carbon dioxide removal, see [this recently released report by Ocean Visions and the Monterey Bay Aquarium Research Institute](#).
- Monitoring/measuring, reporting, and verification (MRV) challenges for ocean-based carbon dioxide removal are significant, and a suite of observational and modeling tools need to be developed and supported to overcome the MRV challenges. These tools must be broadly accepted and used by all stakeholders to ensure consistency in reported quantities of carbon removed.
- Inclusive governance systems need to be developed for ocean-based climate solutions that balance the risks of testing new solutions against the risks of failing to develop adequate solutions to the climate crisis. Governance systems should also facilitate information sharing to ensure that ocean-based climate solutions develop equitably and can scale rapidly.

What existing technologies might advance implementation of ocean-based climate solutions, and what innovations are needed?

Existing technologies in ocean observation and modeling can advance implementation of ocean-based climate solutions, but current technologies are insufficient alone. Breakthroughs in sensor technology are needed to: a) directly measure key parameters of the ocean-climate system that are not yet easily measurable using sensor technology (for example, total alkalinity), b) decrease the cost, and c) increase the durability and usability. Advances in modeling capabilities are needed to seamlessly nest local-scale, regional, and global models in ways that facilitate both research and operational needs, such as by using open-source code and application programming interfaces that make it easy for a diversity of stakeholders to use the models.

How can the benefits of ocean-based climate solutions be shared equitably?

Adherence to a Code of Conduct for Research:

Development of, and adherence to, a code of conduct that governs research activities will be critical for ensuring responsible research into ocean-based climate solutions. Work underway to advance the development and implementation of a code of conduct is being led by the [American Geophysical Union, which is developing an Ethical Framework for Climate Intervention](#), as well as by the Aspen Institute which is [undertaking work to develop a code of conduct to govern ocean-based carbon dioxide removal research](#).

Equitable Distribution of Benefits:

Ocean-based climate solutions can ensure equitable distribution of benefits by:

- Involving stakeholders, including Indigenous groups, at the earliest possible stages of creating and implementing a solution. In some case, such as investigating methods of ocean-based CDR, this means involving all stakeholders in research planning, implementation, and resulting actions. An example of such a partnership is the recent [research and farming deal made between a California climate-tech company and a New Zealand First Nations Tribe](#).
- Carefully and thoroughly assessing trade-offs for a proposed climate solution, including gathering and appropriately weighing community-critical data
- Creating workforce pathways (jobs and job/skills training) that are accessible, inclusive, safe, and diverse
- Ensuring that products from commercial activities, such as decarbonized energy or sustainable seafood, are available and accessible to communities in which products are produced
- Ensuring that regulations around ocean-based solutions promote community agency and involvement

How should we engage communities in local implementation?

“Reach” – Building a Community of Ocean-Climate Problem Solvers

Expansion of the global community of people and institutions working together to test and adapt solutions is an important way of ensuring communities are engaged in local implementation. This includes developing relationships and partnerships that allow for collaboration and co-development of solutions with effected communities. One such effort that has enormous potential to engage communities is the [UN Decade of Ocean Sciences for Sustainable Development](#). This Ocean Decade is a global effort to connect people and create action around ocean health. Goals of the Ocean Decade include ocean-based solutions to ameliorating climate change and building the climate resiliency of critical marine ecosystems and coastal communities. There is tremendous opportunity here to build and engage communities in creation and local implementation of solutions. There are currently over 300 endorsed Ocean Decade Actions around the world, ranging from education programs to hands-on research of critical environments and solutions innovation. Ocean Visions proposed and received endorsement for a [UN Ocean Decade Program](#) and a [UN Ocean Decade Collaborative Center](#) that focuses on building a community of practice around ocean-climate solutions. These initiatives are a great framework to build a vibrant global ecosystem of ocean “solutionists”. Continued US involvement and support of UN Ocean Decade Actions and Programs will help ensure this global effort is successful in achieving its goal of a healthier ocean by 2030.

How should we ensure that ocean-based climate solutions are implemented in ways that do not harm underserved communities?

Responsible research with strict adherence to a code of conduct will be vital to ensuring that ocean-based climate solutions are implemented in ways that do not harm underserved communities. Comprehensive understanding of potential environmental and social risks and co-benefits is crucial, as well as effective engagement with communities and stakeholders to ensure that there is public support before the testing or deployment of any potential solution.

Where and how can the Federal government partner with external stakeholders across regions and sectors to effectively mitigate and adapt to climate change through ocean-based climate solutions?

The US government can use partnerships to aid in climate change mitigation and adaptation efforts by:

- **Streamlining the permitting process for in-water testing of ocean-based climate solutions. This may include setting up pre-permitted testbed sites, like [Pacwave](#), so that ocean-climate solutions can be more quickly tested in real world conditions.**
- Granting access to funds for research, development, and testing of promising solutions in academia and the private sector (e.g., start-ups)
- Supporting the development of policies and laws to govern the research, testing, and deployment of ocean-based carbon dioxide removal techniques. Columbia Law School’s Sabin Center for Climate Change is currently developing a [set of model federal laws to facilitate responsible ocean-based CDR research in US waters](#).
- Clarify, or amend, existing tax incentives to include ocean-based climate mitigation pathways
- Setting up a US government program to procure carbon removal from verifiable high-quality sources
- Setting up a compliance market for carbon removal credits
- Establishing partnerships with and funding [UN Ocean Decade](#) endorsed actions, programs, and projects

What solutions can/should come from outside of government?

Private sector organizations have a major role to play in accelerating ocean-climate solutions. For instance, there is a growing sector of startups working on ocean-based CDR. The [Ocean Visions Launchpad program](#) connects these startup companies with experts from academia and other private sector organizations to help startups develop, test, and validate their technologies. We believe that these partnerships are crucial.

Civil society also has a role in developing innovative solutions, such as through [community ownership models over carbon removal projects](#).