

**NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION  
WRITTEN TESTIMONY OF  
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**LEGISLATIVE HEARING  
ON  
Discussion Draft of H.R. XX, Marine Carbon Dioxide Removal Research and Development  
Act of 2024**

**BEFORE THE  
HOUSE COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY  
U.S. HOUSE OF REPRESENTATIVES**

**SEPTEMBER 19, 2024**

**1. INTRODUCTION**

Chairman Lucas, Ranking Member Lofgren, and Members of the Committee, thank you for the opportunity to testify today regarding NOAA’s work on marine carbon dioxide removal (also known as ocean carbon dioxide removal) and to provide comments regarding the Discussion Draft of H.R. XX, Marine Carbon Dioxide Removal Research and Development Act of 2024.

The United States and the world face a profound climate crisis. We have a narrow opportunity to pursue action at home and abroad to reduce the concentration of greenhouse gases in the atmosphere to avoid the most catastrophic impacts of that crisis, while also adapting to changes already underway and those to come – and doing so equitably. The Biden-Harris Administration, thanks to major investments provided by Congress, is acting decisively to reduce emissions, increase resilience, advance environmental justice, and achieve energy security. However, the Intergovernmental Panel on Climate Change (IPCC) is clear that in addition to deep, rapid, and sustained emission reductions, limiting warming to 1.5 degrees Celsius with no or limited overshoot requires removing legacy carbon dioxide emissions from the atmosphere. Some of these potential solutions would remove carbon dioxide from the atmosphere with the assistance of ocean-based processes. Companies and governments around the world have begun to recognize this reality, and are beginning to develop and test the technologies necessary to conduct marine carbon dioxide removal. This is a potentially major new economic sector with Earth-system impacts that transcend national borders. NOAA therefore views engagement with the field of marine carbon dioxide removal as necessary to ensure safe, accountable development and potential future deployment, as well as continued U.S. scientific leadership.

Marine carbon dioxide removal processes accelerate or augment ocean processes (biological and otherwise) that draw down carbon dioxide from the atmosphere. Non-biological approaches include ocean alkalinity enhancement and electrochemical methods. Alkalinity enhancement makes the ocean more basic, and therefore more able to take up carbon dioxide without accelerating ocean acidification, by introduction of liquid or solid alkaline material. Electrochemical approaches directly remove carbon dioxide from the water via electrical current or membranes, allowing the ocean to take up more carbon dioxide as it reestablishes equilibrium. These two methods are sometimes paired. Biological marine carbon dioxide removal (mCDR) processes alter or enhance the ocean's ability to convert carbon dioxide into biomass that can be stored away at depth from the atmosphere for hundreds to thousands of years. For example, seaweed cultivation and nutrient fertilization methods, including artificial upwelling, aim to increase the amount of carbon dioxide that is turned into organic biomass in the surface ocean, which is then sunk through the water column to the deep ocean, delaying its reentry to the atmosphere. Artificial downwelling is the downward transport of surface water, which aims to increase the amount of carbon that is transported to the deep ocean.

Coastal habitats which serve as carbon sinks are known as coastal blue carbon. At NOAA, we recognize that activities that enhance coastal blue carbon typically focus on restoration and/or conservation of naturally occurring ecosystems services, but under the right circumstances may also contribute to local and regional carbon removal. When these methods are carefully carried out alongside appropriate monitoring, reporting and verification, they can contribute to a carbon dioxide removal portfolio. A coastal blue carbon project may be considered a land- or ocean-based approach depending on the methodology (e.g. mangroves vs seagrass projects).

Due in part to growing interest in the voluntary carbon market and development of compliance markets, some companies are already pursuing small-scale pilot studies for a variety of these technologies. As a Department of Commerce agency, NOAA recognizes the importance of enabling emerging markets and wants to ensure that the methods are effective, verifiable, and accountable, while minimizing risk to ocean ecosystems and communities. At the same time, NOAA is focused on improving its knowledge base regarding the safety, efficacy, and sustainability of each marine carbon dioxide removal pathway. Private industry is already moving forward with carbon dioxide removal pilot projects, highlighting the urgent need for more research. Alongside growing our foundational knowledge, we must partner across the Federal government to develop standards to support an accountable, rigorous carbon market<sup>1</sup>.

Other countries are pushing ahead with marine carbon dioxide removal - and some American companies are moving abroad to gain easier access to permission and economic incentives to test and scale their technologies. As other countries and companies explore altering the ocean to

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<sup>1</sup> <https://www.whitehouse.gov/briefing-room/statements-releases/2024/05/28/fact-sheet-biden-harris-administration-announces-new-principles-for-high-integrity-voluntary-carbon-markets/>

draw down atmospheric carbon dioxide, the U.S. must grow our own knowledge around various marine carbon dioxide removal pathways including potential effects on the ocean and its ecosystems, and must maintain and expand our observing capabilities, in order to ensure we are informed and able to respond to global marine carbon dioxide removal activities. We cannot afford to remain on the sidelines of this field of research – for the climate, for the economic potential of the sector, and, as international interest grows, for our national security.

## **2. NOAA’S LEADING ROLE IN ADVANCING AND COORDINATING FEDERAL AND NON-FEDERAL MARINE CARBON DIOXIDE REMOVAL RESEARCH**

NOAA has four main functions in the Federal approach to marine carbon dioxide removal. First, it is the key agency for foundational ocean and atmospheric research, leveraging its deep oceanic expertise to lead efforts to build knowledge about the efficacy of and potential ecological responses to various marine carbon dioxide removal pathways, as well as leveraging and expanding its oceanic observing capabilities and Earth-system models to better understand the natural baseline condition and variability of the ocean. Second, as a result of this leadership in research, NOAA is a central coordinator of Federal, academic, and philanthropic marine carbon dioxide removal research to inform policymaking. Third, NOAA may issue incidental take authorization under the Marine Mammal Protection Act to the Federal permitting agencies or conduct consultation with the permitting agencies under the Endangered Species Act and/or Magnuson-Stevens Fishery Conservation and Management Act. NOAA also supports the Federal permitting agencies by providing technical guidance on these statutes. Finally, NOAA stewards marine carbon dioxide removal research data within its environmental archive to ensure the data are findable, accessible, interoperable, and reusable by researchers, decision makers and the public.

NOAA is a world leader in understanding the effects of changing ocean carbon chemistry across a broad tapestry of marine species thanks to its ongoing research into the impacts of ocean acidification. The knowledge and facilities from this effort could be leveraged to explore similar effects from marine carbon dioxide removal pathways. Under the 2009 Federal Ocean Acidification Research and Monitoring Act (FOARAM), the Joint Subcommittee on Ocean Science and Technology of the National Science and Technology Council established the Interagency Working Group on Ocean Acidification (IWGOA) to coordinate Federal activities on ocean acidification among thirteen Federal agencies. The scope of science called for under the FOARAM Act expressly includes “oversee[ing] the development of adaptation and mitigation strategies to conserve marine organisms and ecosystems exposed to ocean acidification” to which some proposed marine carbon dioxide removal methods could contribute. Therefore, the IWGOA maintains active coordination around aspects of marine carbon dioxide removal science which intersect with ocean acidification. Examples of this coordination include sustaining national ocean carbon monitoring capacity that encompasses observations obtained from

research vessels, volunteer private industry ships, fixed time-series stations, autonomous underwater and surface vehicles, and state water quality monitoring programs. Importantly, the IWGOA is presently engaged in an initiative to ensure long-term continuity of ocean carbon chemistry reference materials which will be critical to marine carbon dioxide removal Measurement, Monitoring, Reporting, and Verification (MMRV) as the industry emerges.

NOAA's marine carbon dioxide removal research portfolio is presently anchored by its investments via the National Oceanographic Partnership Program (NOPP). In FY22 NOAA began a multi-agency pilot project in collaboration with an industry partner and the Department of Energy (DOE) to explore the feasibility and impact of ocean alkalinity enhancement. This was followed up in FY23 with the first large-scale public and multi-partner competitive research opportunity that sought to examine a broad suite of marine carbon dioxide removal approaches. In total, the initiative supports 17 projects, including laboratory experiments, assessment of biological responses, modeling, field-based studies, and community engagement to be conducted over the next three years. The projects include 47 unique institutions and 79 researchers, from leading academic institutions, industry, NGOs, and government, including five NOAA laboratories. The initiative is primarily made possible by funding provided by Congress through the Inflation Reduction Act, which enables the Administration to advance its commitment to curbing climate change and positioning the US as a leader in cutting-edge science. And, while led by NOAA, this funding call includes funds from other government partners, including U.S. National Science Foundation, Office of Naval Research, and DOE, as well as funds from the nongovernmental organization Climateworks.

Congress has previously given NOAA direction on mCDR research through the NOPP report language in Fiscal Years 23 and 24. Additionally, some of the most high-profile legislation passed in the last four years, including the Bipartisan Infrastructure Law, the Inflation Reduction Act, the Energy Act of 2020, and the CHIPS and Science Act, has included carbon dioxide removal sections, with the IRA providing funding for the previously discussed NOPP research portfolio led by NOAA. Beyond these recent legislative efforts, Congress has also previously provided NOAA with mandates to lead oceanic research via the agency's modeling, monitoring, laboratory and sensing expertise and the statutory authority to ensure the conservation and management of marine resources. All of these capabilities are critical for the extensive foundational research into the efficacy and impacts of marine carbon dioxide removal that the Federal government is undertaking and seeking to expand.

NOAA is also leading these efforts beyond its research portfolio. NOAA is co-chairing, alongside the White House Office of Science and Technology Policy, a Fast Track Action Committee on Marine Carbon Dioxide Removal (MCDR-FTAC), which convened representatives from across the Federal government to produce a research strategy for marine carbon dioxide removal science and to inform potential deployment decision making to inform

potential deployment decision making. This will be a Federal plan that outlines how the U.S. government can support and fill critical knowledge gaps relating to mCDR while identifying environmental, social, and human health responses. The plan highlights goals, principles, and recommendations that will responsibly produce sound science to guide future decision-making. The MCDR-FTAC solicited input from the public, marine carbon dioxide removal invested communities and experts, Tribes and local communities to inform the development of a safe and responsible marine carbon dioxide removal research strategy, which will be released in the Fall.

Beyond the MCDR-FTAC, NOAA has been working very closely with other agencies, particularly DOE, on fostering a whole-of-government collaborative approach to marine carbon dioxide removal work. In June 2024, NOAA and DOE's Office of Fossil Energy and Carbon Management, Office of Science, and Office of Energy Efficiency & Renewable Energy Water Power Technologies Office announced they had signed a Memorandum of Agreement establishing the basis for a collaborative relationship on marine carbon dioxide removal research and development. We are working hand in hand with the DOE to grow both agencies' involvement in marine carbon dioxide removal work, and to coordinate to ensure that there is no duplication of effort and that each agency is focusing its work on areas which play to its strengths. In this relationship, NOAA is leading on basic research into marine carbon dioxide removal's efficacy and potential impacts and co-benefits, as well as ocean, atmosphere, and carbon monitoring capabilities. DOE is poised to lead in scaling up marine carbon dioxide removal pathways, technology development and associated carbon markets. This productive relationship extends back prior to the MOA, with multiple offices in DOE providing funding as part of the NOPP call, including the Office of Fossil Energy and Carbon Management and Water Power Technologies Office. NOAA has also served in an advisory role with DOE's Advanced Research Projects Agency - Energy (or ARPA-E) funding call for innovative sensor technology development projects for marine carbon dioxide removal MRV and plans to continue to do so for future DOE funding calls. NOAA and DOE also currently have a joint Fellow working on marine carbon dioxide removal.

### **3. THE FUTURE OF MARINE CARBON DIOXIDE REMOVAL AT NOAA**

In May 2023, NOAA released its first ever Strategy for Carbon Dioxide Removal Research.<sup>2</sup> The NOAA Strategy lays out a vision for how NOAA can work with its partners to address carbon dioxide removal knowledge gaps, and highlights the agency's four key asset classes that are the critical foundation for marine carbon dioxide removal research. First, NOAA has the largest network of marine carbon observations in the world – leveraging and expanding this network to ensure robust, sustained, and verifiable ocean observations is critical to assess the efficacy of marine carbon dioxide removal. This is not only important for research, but critical to ensure that

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<sup>2</sup> <https://sciencecouncil.noaa.gov/wp-content/uploads/2023/06/mCDR-glossy-final.pdf>

future carbon credits from marine carbon dioxide removal are accountable and verifiable. Second, NOAA's Earth system models are currently being expanded to assess the impact of marine carbon dioxide removal on the global climate, as well as to examine the potential harms and co-benefits on ecosystems from scaled marine carbon dioxide removal research and deployments. Third, research on environmental responses must be carried out alongside research into marine carbon dioxide removal efficacy. Observations and assessments of marine species and ecosystems are critical for evaluating the potential impacts of marine carbon dioxide removal approaches, including those focused on fisheries and protected species. NOAA is a leader in ocean observations, modeling, and foundational ocean knowledge, and has considerable infrastructure from the related field of ocean acidification and carbon cycle science.

The NOAA Strategy also lays out three waves of research to achieve our vision of an effective, informed, and responsible marine carbon dioxide removal field. The first wave is focused on foundational research. Specific items include conducting laboratory bench studies, designing and growing local to regional ocean carbon observations, developing modeling packages, supporting permitting processes and stakeholder engagement. Some of this work, specifically lab and modeling work, is ongoing. NOAA is exploring options for increasing future resources for this work. Wave 2 focuses on engaging with field trials and scaling approaches through the year 2030. Actions include synthesizing research results, process studies on ecosystem impacts including higher trophic levels, taking part in large-scale controlled demonstration projects, assessments of risks of approaches, and comparing/contrasting cost-benefit analysis studies. Lastly, Wave 3 involves mature global monitoring of gigaton-scale marine carbon dioxide removal. This would support expansion of public-private partnerships and increase safeguarding of the marine environment from marine impacts of large-scale deployment.

#### **4. SUMMARY OF THE COMMITTEE'S PROPOSED LEGISLATION**

NOAA appreciates the Committee's dedicated work on legislation to guide marine carbon dioxide removal work.

Section two of the bill provides clear and accurate definitions of relevant terms. Section three authorizes NOAA, in collaboration with DOE, to establish an mCDR research program. It further provides a comprehensive list of activities and research topics for each agency, clearly delineating each agency's role and encouraging the continued collaborative work that the mCDR-FTAC has started. NOAA notes that the bill does not authorize additional appropriations, which would require NOAA to reduce other activities to fund new MCDR activities.

Section four establishes an mCDR steering committee composed of federal and non-federal experts to establish a national mCDR research plan, including providing environmental analysis of potential sites for mCDR Research Centers. The proposed research plan would include

sections on the current understanding of mCDR, a code of conduct, the suitability of freshwater environments for mCDR, and performance-based criteria, among others, though NOAA notes it may in places be duplicative of work that the FTAC has already carried out. Section five directs DOE, in collaboration with NOAA, to establish the mCDR Research Centers discussed in the steering committee's report, and seeks to ensure the Centers avoid duplication of effort across the government. It also directs the centers to, among other things, consistently engage local communities particularly to promote economic growth. Finally, section six establishes NOAA as the federal government's lead agency for international mCDR coordination and U.N. engagement. NOAA appreciates this role, but notes that the Department of State is the lead U.S. agency for all engagement in international fora such as the United Nations; agencies such as NOAA can provide State with expertise as needed.

NOAA is happy to provide technical assistance to Congress as they further consider this bill.

## **5. CONCLUSION**

NOAA is the nation's foremost source of ocean science expertise. The ongoing climate crisis will continue to drive interest in developing the field of marine carbon dioxide removal. With many outstanding questions about proposed marine carbon dioxide removal pathways' effectiveness and ecosystem responses, NOAA has a critical role to play in building the knowledge necessary to keep the U.S. positioned as a responsible leader in the field and in climate mitigation more broadly. NOAA cannot do this alone, however; partnerships within and outside of the government enable a comprehensive response to the scientific, technical, and economic questions and opportunities raised by marine carbon dioxide removal.