OCEAN CLIMATE ACTION PLAN

A REPORT BY THE OCEAN POLICY COMMITTEE

MARCH 2023

THE WHITE HOUSE
WASHINGTON

Letter from the Co-Chairs of the Ocean Policy Committee

President Biden and Vice President Harris have made clear from day one that climate change is a profound threat—to the health and safety of our families and communities, our economy, and global security—that requires urgent and transformative action at all levels of government, civil society, and in all parts of the planet. As co-chairs of the Ocean Policy Committee (OPC), we know that the ocean holds unrealized potential to catalyze action to tackle this threat. The ocean—including the open ocean, coasts, estuaries, the U.S. Arctic, the Great Lakes, and U.S. territories—spans 70 percent of the globe, from shallow bays to the depths and areas beyond any nation's jurisdiction. And although climate change is having numerous unprecedented impacts on the ocean, the ocean also has the potential to advance a powerful set of solutions to address the climate crisis. That is why, on World Ocean Day in 2022, President Biden announced that his Administration would develop and implement a first-ever, whole-of-government Ocean Climate Action Plan (OCAP)—and he tapped us to do it.

Our approach exemplifies the President and Vice President's focus on *science as possibility*, specifically tapping the power of knowledge, science, technology, and innovation to open doors so we can step beyond the limitations of today into a different tomorrow—a better tomorrow. We seek to unleash the benefits that help realize the ambitions of every person in this country—in this case, for a stable climate, good jobs and healthy economies, and an equitable and just society. These key priorities of the Biden-Harris Administration are incorporated throughout the OCAP.

We are proud of the work of the Ocean Policy Committee to advance ocean science and technology, identify priority ocean research and technology needs, and leverage resources and expertise to maximize the effectiveness of Federal investments in ocean research and ocean resource management. And we are especially eager to present to the public the OCAP.

The OCAP outlines three goals that mobilize the Federal Government and civil society to take effective and innovative ocean climate action: (1) create a carbon-neutral future, without emissions that cause climate change and harm human health, (2) accelerate solutions that tap the power of natural coastal and ocean systems to absorb and store greenhouse gases, reduce the climate threat, and protect communities and ecosystems against unavoidable changes, and (3) enhance community resilience to ocean change by developing ocean-based solutions that help communities adapt and thrive in our changing climate. The actions described in the OCAP also provide other benefits—good-paying jobs, workforce innovation, resilient food production, ecosystem health, and scientific knowledge.

To reach these ambitious goals, the OCAP maps out eight priority actions—including increasing offshore wind and marine energy, decarbonizing the maritime shipping sector, conserving and restoring coastal and marine habitats that naturally store carbon ("blue carbon"), and expanding protected areas in the ocean ("marine protected areas")—to enhance resilience of ocean ecosystems that provide food, jobs, recreational opportunities, cultural identity, and more. Guiding these actions is a commitment to be responsible stewards of a healthy and sustainable ocean; advance environmental justice; engage with communities, Tribal Nations, and Indigenous Peoples; act based on evidence, science, and Indigenous Knowledge; and integrate and coordinate actions across the Federal Government.

This plan should not be viewed as an exhaustive list of ocean activities, but rather a plan focused specifically on ocean climate action. There are many critically important ocean research, policy, and management actions across the Federal Government that are not included, like our work to restore endangered and threatened species, stop pollution from entering our waterways and ocean, and connect people with safe and equitable access to nature. Climate is the focus of this plan, but our work to ensure a healthy, sustainable, and prosperous nation encompasses all aspects of the ocean and environment.

We have a narrow moment to pursue action in order to avoid the most catastrophic impacts of the climate crisis and to seize the opportunities that tackling climate change presents. The OCAP offers a unique opportunity to drive action on the Biden-Harris Administration's ocean-climate priorities—to advance climate solutions, promote environmental justice, and ensure sustainable coastal communities and a healthy and sustainable ocean economy. Together, these actions further our leadership in taking on the threat of climate change, caring for our environment, and enhancing the economic and ecological sustainability of the ocean, coasts, and Great Lakes for generations to come.

Importantly, the Federal Government acting alone is nowhere near as powerful as the collective action of every person in this country. We invite everyone to join us in leveraging the OCAP to take action and drive change.

Sincerely,

Arati Prabhakar
Assistant to the President for Science and Technology
Director, White House Office of Science and Technology Policy
Co-Chair of the Ocean Policy Committee

Brenda Mallory
Chair, White House Council on Environmental Quality
Co-Chair of the Ocean Policy Committee

Executive Summary

There is no path to a healthy and livable climate without the ocean. Humans can benefit from the ocean's potential to advance transformational, urgent, and immediate actions that address the climate crisis and stem the harms that climate change is already causing to coastal communities, marine resources, and the sustainable ocean economy. That's why the Biden-Harris Administration developed this first-ever, whole-of-government Ocean Climate Action Plan (OCAP) to advance climate solutions, promote environmental justice, create good-paying jobs, and ensure sustainable coastal communities and a healthy ocean economy. Recognizing that effective action will require broad national participation, the OCAP was developed with input from across the Federal Government, Tribal Nations, other Indigenous Peoples, stakeholders, and the public.

The plan outlines the ocean climate actions needed to meet three goals:

(1) **Create a carbon-neutral future** without harmful emissions that cause climate change,

(2) **Accelerate nature-based solutions** to protect and support natural coastal and ocean systems that store greenhouse gases, reduce the climate threat, and protect communities and ecosystems against unavoidable changes, and

(3) **Enhance community resilience to ocean change** by developing ocean-based solutions that help communities adapt and thrive in our changing climate.

The OCAP directs near-term actions to reach these goals. For example, increasing offshore wind and marine energy, decarbonizing the maritime shipping sector, and advancing marine carbon dioxide removal and storage technologies will provide powerful levers for reducing net greenhouse gas emissions, contributing significantly to a carbon-neutral future. Conserving and restoring coastal and marine habitats that naturally store carbon ("blue carbon") and expanding protected areas in the ocean ("marine protected areas") that can help respond to the changing climate will advance nature-based ocean climate actions. These nature-based ocean climate actions generate multiple benefits for slowing and responding to climate change, stemming the loss of biodiversity, and supporting people and communities, especially those who directly depend on the coasts and the ocean. The OCAP outlines additional ways to protect coastal communities and enhance the resilience of fisheries, aquaculture, and fishing communities who are dependent on the ocean, thus bolstering community resilience to changing ocean conditions. Guiding these actions are overarching commitments to be responsible stewards of a healthy and sustainable ocean; to advance environmental justice; to engage with communities, Tribal Nations and Indigenous Peoples, including Native Americans, Alaska Natives, Native Hawaiians, and Indigenous Peoples of the U.S. Territories; to engage in robust outreach; to act based on sound science, evidence, and knowledge; and to integrate and coordinate actions across the Federal Government.

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About the Ocean Policy Committee

The Ocean Policy Committee (OPC) was codified by the National Defense Authorization Act for Fiscal Year 2021 to coordinate Federal actions on ocean-related matters. The OPC traces its roots to the National Ocean Council created by Executive Order 13547[1] and the Ocean Policy Committee established by Executive Order 13840[2]. The OPC is co-chaired by the Director of the Office of Science and Technology Policy (OSTP) and the Chair of the Council on Environmental Quality (CEQ)[3] and is directed to engage and collaborate with the ocean community on ocean-related matters, facilitate coordination and integration of Federal activities in ocean and coastal waters to inform ocean policy, identify priority ocean science and technology needs, and to leverage resources and expertise to maximize the effectiveness of Federal investments in ocean research. For more information about the work of the OPC, please see https://www.noaa.gov/interagency-ocean-policy.

About the Ocean Resource Management Subcommittee

In August 2018, the OPC established the Ocean Resource Management (ORM) Subcommittee to advise and assist on national issues that address regulatory and policy coordination associated with coastal and ocean management.[4] The ORM continued under the OPC under the National Defense Authorization Act for Fiscal Year 2021 and was codified in the NDAA for Fiscal Year 2023.[5]

About the Council on Environmental Quality

The Council on Environmental Quality (CEQ) was established within the Executive Office of the President by the National Environmental Policy Act of 1969 (NEPA).[6] CEQ advises the President and develops policies on climate change, environmental justice, Federal sustainability, public lands, oceans, and wildlife conservation, among other areas. As the agency responsible for implementing NEPA, CEQ also works to ensure that environmental reviews for infrastructure projects and Federal actions are thorough, efficient, and reflect the input of the public and local communities. For more information, please see: https://www.whitehouse.gov/ceq.

About the Office of Science and Technology Policy

The Office of Science & Technology Policy (OSTP) was established by the National Science and Technology Policy, Organization, and Priorities Act of 1976 to provide the President and others within

[1] Exec. Order No. 13547—June 19, 2010, *reprinted in* 83 Fed. Reg. 3,13547 (July 22, 2018). https://obamawhitehouse.archives.gov/the-press-office/executive-order-stewardship-ocean-our-coasts-and-great-lakes.

[2] Exec. Order No. 13840—June 19, 2018, *reprinted in* 83 Fed. Reg. 29,431 (June 22, 2018). https://trumpwhitehouse.archives.gov/presidential-actions/executive-order-regarding-ocean-policy-advance-economic-security-environmental-interests-united-states/.

[3] William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021, Pub. L. No. 116-283, § 1055(b), 134 Stat. 3388, 3851 (codifying 10 U.S.C. § 8932). https://www.congress.gov/bill/116th-congress/house-bill/6395

[4] NOAA. Ocean Resource Management Subcommittee. https://www.noaa.gov/ocean-resource-management-subcommittee. Last accessed March 2022.https://www.noaa.gov/ocean-resource-management-subcommittee. Last accessed March 2023.

[5] William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021, Pub. L. No. 116-283, § 1055(b), 134 Stat. 3388, 3851 (codifying 10 U.S.C. § 8932). https://www.congress.gov/bill/116th-congress/house-bill/6395; James M. Inhofe National Defense Authorization Act for Fiscal Year 2023, Pub. L. No. 117-263 (H.R. 7776, Section 10303(a) (amending 10 U.S.C. § 8932(c)(1)(B) to specifically include the Ocean Resource Management Subcommittee)). https://www.congress.gov/117/bills/hr7776/BILLS-117hr7776enr.pdf.

[6] 42 U.S.C. §§ 4321 et seq.

the Executive Office of the President with advice on the scientific, engineering, and technological aspects of the economy, national security, homeland security, health, foreign relations, the environment, and the technological recovery and use of resources, among other topics.[7] As a Cabinet-level office in the Biden-Harris Administration, OSTP leads interagency science and technology policy coordination efforts, assists the Office of Management and Budget with an annual review and analysis of Federal research and development in budgets, and serves as a source of scientific and technological analysis and judgment for the President with respect to major policies, plans, and programs of the Federal Government. More information is available at http://www.whitehouse.gov/ostp.

About this Document

This document was developed by the Ocean Climate Action Plan workgroup of the Ocean Resource Management Subcommittee of the Ocean Policy Committee. This document serves to guide and coordinate actions of the Federal Government and civil society to address ocean, coastal, and Great Lakes-based mitigation and adaptation solutions to climate change, while building resilience to impacts.

Copyright Information

[7] National Science and Technology Policy, Organization, and Priorities Act of 1976, Pub. L. No. 94-282, 90 Stat. 459.

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The first-ever U.S. Ocean Climate Action Plan focuses on some of the most important ocean ecosystems and marine activities. Given its reach and timeliness, the OCAP could not have been developed without input from those who know the ocean best. The OPC Co-Chairs are deeply grateful to the Tribal Nations that participated in the formal consultation process, and to the Indigenous Peoples and Tribal Nations who provided input during a series of other engagements - the knowledge shared during these sessions was crucial to shaping the contours of this action plan. Scientific and non-profit organizations, academic institutions, and industry partners shared valuable input on the scientific underpinnings of the OCAP and on the research and development priorities identified therein. Many of these entities are already taking bold actions to tackle the climate crisis, and they will continue to be essential partners in bringing the OCAP actions to fruition. The OPC Co-Chairs extend their sincere appreciation to the Federal scientists, subject matter experts, and outreach and engagement specialists for their contributions to this action plan and for their commitment to addressing the challenge posed by the climate crisis. The OPC Co-Chairs thank the members of the public who contributed their knowledge

and shared their priorities to inform the OCAP in response to a request for input. The release of the OCAP is not the end of this engagement. It is a crucial step in the process of collaborating across all aspects of society to tackle climate change head on.

List of Acronyms and Abbreviations

AI - Artificial Intelligence
AIS - Automatic Identification Systems
BIL - Bipartisan Infrastructure Law (formally known as the Infrastructure Investment and Jobs Act, P.L. 117-58)
BOEM - U.S. Bureau of Ocean Energy Management
BSEE - Bureau of Safety and Environmental Enforcement
CDR - Carbon Dioxide Removal
CEFI - Climate, Ecosystems, and Fisheries Initiative
CEQ - Council on Environmental Quality
CH_4 - Methane
CMTS - U.S. Committee on the Marine Transportation System
CO_2 - Carbon Dioxide
COP15 - 15th Session of the Convention on Biological Diversity
COP26 - 26th Session of the Conference of Parties of the United Nations Framework Convention on Climate Change
COP27 - 27th Session of the Conference of Parties of the United Nations Framework Convention on Climate Change
CR-IWG – Coastal Resilience Interagency Working Group
DEIJA - Diversity, Equity, Inclusion, Justice, and Accessibility
DOC – U.S. Department of Commerce
DOD – U.S. Department of Defense
DOE - U.S. Department of Energy
DOI - U.S. Department of the Interior
DOT - U.S. Department of Transportation
EEZ – Exclusive Economic Zone
EJ - Environmental Justice
EPA - U.S. Environmental Protection Agency
FDA - U.S. Food and Drug Administration
FEMA - Federal Emergency Management Agency
FWS - U.S. Fish and Wildlife Service
GW - Gigawatts
GHG - Greenhouse Gas
HUD - U.S. Department of Housing and Urban Development
IUU - Illegal, Unreported, and Unregulated
IPCC - Intergovernmental Panel on Climate Change
IRA - Inflation Reduction Act of 2022 (P.L. 117-169)
IWG - Interagency Working Group
MARAD - U.S. Maritime Administration
MMC - Marine Mammal Commission
MMRV - Measuring, Monitoring, Reporting, and Verification
MOU - Memorandum of Understanding
MPA - Marine Protected Areas
MPRSA - Marine Protection, Research, and Sanctuaries Act
MTS – Marine Transportation System

NASA - National Aeronautics and Space Administration
NASEM - National Academies of Sciences, Engineering, and Medicine
NEPA - National Environmental Policy Act
NGGI - National Greenhouse Gas Inventories
NGO - Non-governmental Organization
NOAA - National Oceanic and Atmospheric Administration
N_2O - Nitrous Oxide
NOPP - National Oceanographic Partnership Program
NPS - National Park Service
NSF - National Science Foundation
NSC – National Security Council
OA - Ocean Acidification
OA-AP - Ocean Acidification Action Plan
OCAP - Ocean Climate Action Plan
OCS - Outer Continental Shelf
OEQ - Office of Environmental Quality
OIA - Office of Insular Affairs
OMB - Office of Management and Budget
ONR - Office of Naval Research
OPC - Ocean Policy Committee
OSTP - Office of Science and Technology Policy
PIDP - Port Infrastructure Development Program
R&D - Research and Development
RD&T - Research, Development, and Technology
RD&D - Research, Development, and Demonstration
SDWA - Safe Drinking Water Act
State – U.S. Department of State
STEM - Science, Technology, Engineering, and Mathematics
UAV - Underwater Autonomous Vehicle
UN - United Nations
USACE - U.S. Army Corps of Engineers
USAID - U.S. Agency for International Development
USCG - U.S. Coast Guard
USDA - U.S. Department of Agriculture
USGS - U.S. Geological Survey
UUV - Uncrewed Underwater Vehicle

Introduction

Climate change is a profound threat that requires urgent and transformative action at all levels of government and in all corners of the planet.[8] The ocean, including the open ocean, coasts, estuaries, the U.S. Arctic, the Great Lakes, and U.S. Territories, spans 70% of the globe from shallow bays to the depths and areas beyond any nation's jurisdiction.[9] The ocean area of the U.S. Exclusive Economic Zone is one and a half times the area of the continental U.S., and our waters are not immune to the impacts of climate change. From the Arctic to the Mariana Islands, and the Great Lakes to Puerto Rico, our ecosystems, coastal communities, and the ocean economy are already experiencing tremendous change.[10]

Although the ocean is experiencing the effects of climate change, the ocean is also a powerful tool to address the climate crisis.[11] The ocean can help generate renewable energy through offshore wind and marine energy, helping to transition the Nation away from fossil fuels that drive climate change. The ocean also removes and stores carbon dioxide (CO_2) from the atmosphere in natural systems; other technologies allow captured CO_2 to be stored under the seabed.[12] Industries that depend on the ocean, like maritime shipping and ports, can innovate their operations, with vessels shifting to zero-greenhouse gas (GHG) emission fuels that reduce their contribution to climate change and improve air quality.[13] Protecting and restoring ocean ecosystems, making fisheries and aquaculture climate-ready, supporting climate-smart tourism and recreation, and enhancing the resilience of coastal areas will all contribute directly to ameliorating the impacts of climate change on the ocean and communities. Together, these actions will help the Nation and the world keep climate change below catastrophic levels and make the Nation more prepared for the challenges that we already face. Undertaking the actions described in the Ocean Climate Action Plan (OCAP) will provide other benefits, such as new, well-paying and sustainable jobs, a diverse workforce, and equitable access to the ocean and coasts, as well as more resilient global food production and future ocean discovery and innovation.

The OCAP is a critical component of the Biden-Harris Administration's plans to mitigate climate change, protect biodiversity, create good-paying jobs, and enhance the resilience of communities and ecosystems. The OCAP responds to the following calls to action:

[8] Exec. Order 14008, Tackling the Climate Crisis at Home and Abroad, https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/27/executive-order-on-tackling-the-climate-crisis-at-home-and-abroad/, *reprinted in* 86 Fed. Reg. 7619 (Feb. 1, 2021).

[9] For the purposes of this document, collectively, the "ocean", except where specifically described otherwise, includes the open ocean, coasts, estuaries, the U.S. Arctic Ocean, the Great Lakes, and the ocean and coasts surrounding U.S. territories.

[10] U.S. Global Change Research Program, Fourth National Climate Assessment (2018), https://www.globalchange.gov/nca4/; Intergovernmental Panel on Climate Change, 6th Assessment Report (2021-2022), https://www.ipcc.ch/assessment-report/ar6/.

[11] Hoegh-Guldberg, O., Caldeira K., Chopin. T. et al. (2019). The Ocean as a Solution to Climate Change: Five Opportunities for Action. World Resources Institute. https://oceanpanel.org/wp-content/uploads/2022/06/HLP_Report_Ocean_Solution_Climate_Change_final.pdf; Hoegh-Guldberg, O., Northrop, E. & Lubchenco, J. (2019). The ocean is key to achieving climate and societal goals. *Science* 365(6460): 1372-1374 https://www.science.org/doi/10.1126/science.aaz4390.

[12] GESAMP (2019). High level review of a wide range of proposed marine geoengineering techniques. (Boyd, P.W. and Vivian, C.M.G., eds.). (IMO/FAO/UNESCO-IOC/UNIDO/WMO/IAEA/UN/UN Environment/ UNDP/ISA Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection). Rep. Stud. GESAMP No. 98. http://www.gesamp.org/publications/high-level-review-of-a-wide-range-of-proposed-marine-geoengineering-techniques.

[13] U.S. Committee on the Marine Transportation System. An Assessment of the U.S. Marine Transportation System (2022) https://doi.org/10.21949/1524622.

- Provide 40% of the overall benefits of certain Federal investments, including climate change investments, to disadvantaged communities that have been historically marginalized, underserved, and overburdened by pollution;[14]
- Deploy 30 gigawatts (GW) of energy from offshore wind by 2030;[15]
- Deploy 15 GW of energy from floating offshore wind platforms by 2035;[16]
- Conserve at least 30% of U.S. lands and waters by 2030;[17]
- Identify opportunities for scaling up nature-based solutions to address climate change, strengthen communities, and support local economies;[18] and
- Achieve, working with countries in the International Maritime Organization, zero greenhouse gas emissions from international shipping by no later than 2050.[19]

The OCAP also offers opportunities to build on unprecedented investments to address the climate crisis. Under the leadership of President Biden, the 117th Congress enacted the most consequential pieces of legislation to address the climate crisis in U.S. history: the Infrastructure Investment and Jobs Act, also known as the Bipartisan Infrastructure Law (BIL), and the Inflation Reduction Act (IRA).[20,21] The generational investments in BIL and IRA will accelerate growth in the clean energy economy, reduce pollution, cut energy costs, protect ecosystems, and enhance climate resilience while creating millions of high-quality jobs and ensure that no communities are left behind.

The BIL invests $1.9 billion to restore nationally significant estuaries and tackle hypoxia in the Gulf of Mexico to protect fisheries, improve water quality, and increase resilience across coastal communities.[22] [23] The BIL is also transforming the Nation's ports, historically a significant source of air and water pollution, with $2.25 billion directed to the Maritime Administration's Port Infrastructure

[14] Exec. Order 14008, Tackling the Climate Crisis at Home and Abroad, https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/27/executive-order-on-tackling-the-climate-crisis-at-home-and-abroad/, *reprinted in* 86 Fed. Reg. 7619 (Feb. 1, 2021).

[15] The White House, FACT SHEET: Biden Administration Jumpstarts Offshore Wind Energy Projects to Create Jobs (Mar. 29, 2021), https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/29/fact-sheet-biden-administration-jumpstarts-offshore-wind-energy-projects-to-create-jobs/.

[16] The White House, FACT SHEET: Biden-Harris Administration Announces New Actions to Expand U.S. Offshore Wind Energy (Sept. 15, 2022), https://www.whitehouse.gov/briefing-room/statements-releases/2022/09/15/fact-sheet-biden-harris-administration-announces-new-actions-to-expand-u-s-offshore-wind-energy/.

[17] Exec. Order 14008, Tackling the Climate Crisis at Home and Abroad, https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/27/executive-order-on-tackling-the-climate-crisis-at-home-and-abroad/ *reprinted in* 86 Fed. Reg. 7619 (Feb. 1, 2021).

[18] The White House, FACT SHEET: Biden-Harris Administration Announces Roadmap for Nature-Based Solutions to Fight Climate Change, Strengthen Communities, and Support Local Economies (Nov. 8, 2022), https://www.whitehouse.gov/briefing-room/statements-releases/2022/11/08/fact-sheet-biden-%e2%81%a0harris-administration-announces-roadmap-for-nature-based-solutions-to-fight-climate-change-strengthen-communities-and-support-local-economies/.

[19] The White House, FACT SHEET: President Biden's Leaders Summit on Climate (April 23, 2021), https://www.whitehouse.gov/briefing-room/statements-releases/2021/04/23/fact-sheet-president-bidens-leaders-summit-on-climate/.

[20] Congress.gov. "H.R.3684 - 117th Congress (2021-2022): Infrastructure Investment and Jobs Act." November 15, 2021. https://www.congress.gov/bill/117th-congress/house-bill/3684.

[21] H.R.812 - 118th Congress (2023-2024): Inflation Reduction Act of 2023." *Congress.gov*, Library of Congress, 3 February 2023, https://www.congress.gov/bill/118th-congress/house-bill/812.

[22] The White House, ICYMI: Biden-Harris Administration Works with Global Partners to Drive Ocean Action to Combat the Climate Crisis and Boost Ocean Economy at UN Ocean Conference (July 1, 2022), https://www.whitehouse.gov/ceq/news-updates/2022/07/01/in-case-you-missed-it-biden-harris-administration-works-with-global-partners-to-drive-ocean-action-to-combat-the-climate-crisis-and-boost-ocean-economy-at-un-ocean-conference/.

[23] The White House, FACT SHEET: Biden-Harris Administration Announces Roadmap for Nature-Based Solutions to Fight Climate Change, Strengthen Communities, and Support Local Economies (Nov. 8, 2022), https://www.whitehouse.gov/briefing-room/statements-releases/2022/11/08/fact-sheet-biden-%E2%81%A0harris-administration-announces-roadmap-for-nature-based-solutions-to-fight-climate-change-strengthen-communities-and-support-local-economies/.

Development Program (PIDP); more than 60% of the awards made by the PIDP in 2022 were to ports located in historically disadvantaged communities, consistent with the goals and priorities of the Biden-Harris Administration with respect to climate resilience and the Justice40 initiative.[24] The BIL also dedicates approximately $250 million to reduce emissions, improve air quality, advance offshore wind and marine energy.[25] [26] These are among the many examples of BIL investments in ocean climate action.

The IRA goes even further. With $369 billion for climate and clean energy, it represents the single most transformative action the United States has taken to tackle the climate crisis and create clean energy solutions in American history. For example, the IRA includes critical investments and production tax credits for offshore wind that will enable a transition to a clean energy economy in a manner that supports well-paying jobs and a domestic supply chain. In addition to significant investments in renewable energy generation and carbon dioxide removal, the IRA directs more than $45 billion to environmental justice,[27] $3 billion for port emissions reduction[28], and over $4 billion to increase coastal resilience and conservation, including resources to advance climate-ready fisheries.[29] Additional investments are targeted to nature-based solutions such as the protection, restoration, and enhancement of carbon-rich wetlands.[30]

The Biden-Harris Administration recognizes both the urgency and the opportunity of ocean climate action, and the public does too.[31] The ideas presented in the OCAP reflect a strong consensus that the ocean holds great promise for strong climate solutions. In developing the OCAP, we recognize that the ocean, land, and atmosphere are inherently interconnected. Given that the Biden-Harris Administration has already laid out numerous actions to pursue climate change solutions on land, this plan focuses on the opportunities provided by ocean-based actions, prioritized by their readiness, urgency, scientific support, and near-term[32] climate benefits. Many of the actions identified in this report can move forward based on mature science and technology, while others require further research and investments that will strengthen ocean climate action outcomes in the near term and open new avenues for action in the future.[33] For those efforts where agencies already have authority, the urgency

[24] U.S. Department of Transportation Maritime Administration. Bipartisan Infrastructure Law: Maritime Administration. https://www.maritime.dot.gov/about-us/bipartisan-infrastructure-law-maritime-administration#:~:text=BIL%20designates%20%24450%20million%20annually%20for%20the%20next,available%20this%20year%20to%20more%20than%20%24680%20million. Last accessed March 2023.

[25] U.S. Dep't of Transp., U.S. Transportation Secretary Pete Buttigieg Announces Over $241 Million in Grants for America's Ports (Dec. 23, 2021), https://www.transportation.gov/briefing-room/us-transportation-secretary-pete-buttigieg-announces-over-241-million-grants-americas.https://www.transportation.gov/briefing-room/us-transportation-secretary-pete-buttigieg-announces-over-241-million-grants-americas.

[26] U.S. Dep't of Transp., Maritime Administration. Biden-Harris Administration Announces More Than $703 Million to Improve Port Infrastructure, Strengthen National Supply Chains, Lower Costs (October 28, 2022), https://www.maritime.dot.gov/newsroom/biden-harris-administration-announces-more-703-million-improve-port-infrastructure.

[27] EPA. Inflation Reduction Act: Advancing Environmental Justice. https://www.epa.gov/inflation-reduction-act/advancing-environmental-justice. Last accessed March 2023.

[28] Inflation Reduction Act, Pub. L. No. 117-169, § 60102, 136 Stat. 1818, 2064 (2022).

[29] NOAA. Statement from NOAA Administrator on signing of historic Inflation Reduction Act. (August 16, 2022). https://www.noaa.gov/news-release/statement-from-noaa-administrator-on-signing-of-historic-inflation-reduction-act.

[30] The White House, FACT SHEET: Biden-Harris Administration Announces Roadmap for Nature-Based Solutions to Fight Climate Change, Strengthen Communities, and Support Local Economies (Nov. 8, 2022), https://www.whitehouse.gov/briefing-room/statements-releases/2022/11/08/fact-sheet-biden-%E2%81%A0harris-administration-announces-roadmap-for-nature-based-solutions-to-fight-climate-change-strengthen-communities-and-support-local-economies/.

[31] The development of the OCAP was informed by public comments submitted in response to a Federal Register Notice posted October 4th, 2022, 87 Fed. Reg. 60,228 (Oct. 4, 2022), https://www.federalregister.gov/d/2022-21480.

[32] For the purposes of this document, nearNear-term is defined by 5-10 years.

[33] National Academies of Sciences, Engineering, and Medicine. (2022). Cross-Cutting Themes for U.S. Contributions to the UN Ocean Decade. https://doi.org/10.17226/26363. https://doi.org/10.17226/26363.

of the climate crisis must be met with immediate action. For efforts that require interagency collaboration or new authority, the relevant offices, departments, and agencies must act with all deliberate speed. The OPC provides one key mechanism for this coordination.

The OCAP connects the dots across these and other efforts underway to spotlight the key role of the ocean in achieving the Nation's climate, equity, economic, and nature goals.[34] The OCAP will serve as a guide for Federal agencies as they look to meet the Administration's climate goals and implement BIL and IRA in coastal, ocean, and Great Lakes programs. Unless otherwise noted, the actions listed throughout this document will be carried out by the responsible agencies, with the OPC serving as a coordinating body when required. Departments and agencies should use the OCAP to inform their submissions for the President's Fiscal Year 2025 Budget and beyond. The United States could also rely on the OCAP to develop a National Plan for a Sustainable Ocean Economy, consistent with the United States' commitment in joining a multi-national initiative referred to as the High-Level Panel for a Sustainable Ocean Economy.[35] The OCAP could also be an important resource to inform the emerging National Nature Assessment.[36] The OCAP's implementation will not only require actions by the departments and agencies explicitly listed, but its success will also be dependent on support from other agencies and external partners with relevant expertise and resources.

Structure of the OCAP

Overarching and cross-cutting principles that informed the OCAP actions are presented first; they will guide its implementation. These principles reflect a commitment to be responsible stewards of a healthy and sustainable ocean; to advance environmental justice; to engage with Tribal Nations, Indigenous Peoples, and communities; to engage in robust outreach; to act based on sound science, evidence and knowledge; and to integrate and coordinate actions across the Federal Government.

Specific ocean-climate actions are then organized based on three broad goals: (1) ***Create a Carbon-Neutral Future*** by reducing pollution that causes climate change and other actions, (2) ***Accelerate Nature-Based Solutions*** that store greenhouse gases and protect communities and ecosystems against the unavoidable changes, and (3) ***Enhance Community Resilience to Ocean Change*** by helping coastal communities and the many components of the sustainable ocean economy adapt to climate impacts. Each is briefly described below.

A *Carbon-Neutral Future* – where CO_2 emissions (the most important greenhouse gas emitted by human activities that drive climate change) and other GHG emissions are reduced sharply and any remaining GHG emissions are offset by the rate at which CO_2 is removed from the atmosphere and stored – could be supported through several ocean-based actions, such as advancing offshore wind and clean marine energy, accelerating green maritime shipping to further reduce pollution, and investigating ways to sequester more carbon in the ocean environment.

Nature-Based Solutions in the ocean and coastal environment can also help reduce potential greenhouse gas emissions and store carbon, limiting further climate change, and help adapt to the

[34] While the Biden-Harris Administration has made it clear that the future requires a phase-out of fossil fuels, it is also committed to the successful implementation of the IRA, which includes Congressionally-mandated offshore oil and gas leasing requirements.
[35] U.S. Dept. of State. Joining the High-Level Panel for a Sustainable Ocean Economy (Nov. 2, 2021). https://www.state.gov/joining-the-high-level-panel-for-a-sustainable-ocean-economy/.
[36] National Nature Assessment. U.S. Global Change Research Program. https://www.globalchange.gov/nna. Last accessed March 2023.

changing environment. The OCAP highlights two types of nature-based solutions: “blue carbon” (restoring and protecting coastal and marine environments that naturally store carbon) and climate-adaptive marine protected areas.

While those living near the coast are uniquely vulnerable to changing ocean conditions, adequate preparation and investment can help these communities become more resilient. The final theme on *Community Resilience* includes actions that develop climate-ready fisheries and aquaculture, aid protected species, bolster coastal communities by building resilience to the negative impacts of climate change, and support a robust and sustainable ocean economy.[37]

The following sections present a Summary Table for a quick overview, then give priority actions for each theme. The Scientific Background provides an overview on climate change, ocean climate impacts, and ocean-based adaptation and mitigation approaches. The report concludes with an Appendix that gives additional information on each priority action, including projected timelines.

[37] For the purposes of this report, we use the term sustainable ocean economy, defined by the World Bank as the “sustainable use of ocean resources for economic growth, improved livelihoods and jobs, and ocean ecosystem health.” The sustainable ocean economy is often also referred to as the blue economy.
The World Bank. MENA Blue Program. https://www.worldbank.org/en/programs/mena-blue-program/overview. Last accessed March 2023.
NOAA. New Blue Economy. https://www.noaa.gov/blue-economy. Last accessed March 2023.https://www.noaa.gov/blue-economy. Last accessed March 2023.

Summary Tables

CROSS-CUTTING PRINCIPLES AND ACTIONS

	Ocean Climate Opportunity	OCAP Actions
Promote Ocean Health and Stewardship	• Stewardship, conservation, and protection of the ocean's existing natural resilience are fundamental to reducing climate-change causing emissions and addressing the climate crisis.	○ Focus on ocean health and stewardship in all Federal ocean activities.
Advance Environmental Justice	• The perspectives and lived experiences of environmental justice communities must be reflected in Federal Government actions, and the impacts of ocean climate action on communities that already face disproportionate burdens must be minimized.	○ Develop an Ocean Justice Strategy that identifies barriers and opportunities to fully integrate environmental justice principles into the Federal Government's ocean activities.
Engage with Tribal Nations and Indigenous Peoples	• The Administration is committed to strengthening Nation-to-Nation relationships through formal consultation with Tribal Nations, and to engaging with Tribal Nations and Indigenous Peoples outside of formal consultation.	○ Commit to early, frequent, and meaningful engagement with Tribal Nations, including through formal Nation-to-Nation Tribal Consultation, and other engagement with Indigenous Peoples. ○ Consider Indigenous Knowledge in advancing actions based on the OCAP. ○ Explore innovative funding mechanisms to improve access to Federal funds for Tribal Nations and Indigenous Peoples.
Strengthen Outreach and Engagement	• Equitable policy requires the frequent and early involvement of those who will be affected by decision making.	○ Establish a mechanism for engaging Federal, Tribal, State and Territorial agencies, the private sector, academia, non-governmental organizations (NGOs), and the public on an ongoing basis.
Accelerate and Use Science, Evidence, and Knowledge	• The priority actions in the OCAP are those for which there is substantial evidence that action will lead to climate benefits while also minimizing unintended consequences to people and the environment. • The OCAP calls for additional research, development, and demonstration to close knowledge gaps and determine the effectiveness of particular actions prior to full-scale implementation, then to incorporate that new knowledge into policy and management.	○ Prioritize Federal ocean research specific to the OCAP themes. ○ Develop recommendations for Federal research priorities specific to the OCAP themes to help guide Federal, academic, and private sector research and engagement. ○ Consider, include, and apply Indigenous Knowledge in research. ○ Pursue innovative ways to incorporate new knowledge into policy and management.

	Ocean Climate Opportunity	OCAP Actions
Facilitate Interagency Coordination and Strategic Planning	• Successful development and implementation of ocean climate actions requires integrated and coordinated action across the Federal Government, through a strategic lens.	○ Integrate and coordinate strategic ocean climate action across the Federal Government – such as that provided by the Ocean Policy Committee – and in partnership with Tribal Nations, Indigenous Peoples, States, Territories, communities, the private sector, and civil society.

CREATE A CARBON-NEUTRAL FUTURE

	Ocean Climate Opportunity	OCAP Actions
Offshore Wind and Marine Energy	• Meet the Biden-Harris Administration's goal to deploy 30 GW of offshore wind by 2030, 15 GW of floating offshore wind by 2035, and to rapidly and responsibly advance the commercialization of marine energy technologies that convert energy from waves, tides, currents, and other ocean sources. • Expand offshore wind and marine energy as an alternative to higher-greenhouse gas emitting energy resources in order to meet the Administration's broader goal to reach 100 percent carbon pollution-free electricity by 2035 and net-zero greenhouse gas emissions economy-wide by no later than 2050.	○ Expand offshore wind and marine energy in an environmentally responsible manner that considers the needs of all users of those lands, coasts, and waters by publishing and periodically evaluating and updating an Offshore Wind Leasing Strategy. ○ Address transmission challenges to facilitate the United States achieving its offshore wind targets. ○ Support innovation in offshore wind and marine energy technologies by expanding research and development. ○ Continue to monitor potential environmental and social impacts of offshore wind and marine energy to inform design and deployment on an ongoing basis. ○ Improve ports, U.S. ships, and domestic supply chains to facilitate offshore wind deployment. ○ Foster partnerships focused on training the workforce needed to rapidly expand and maintain offshore wind energy and marine energy development. ○ Investigate the potential of offshore wind and marine energy to power applications in and beyond the sustainable ocean economy. ○ Facilitate the responsible deployment of offshore wind globally.
Green Maritime Shipping	• Advance the decarbonization of the U.S. Marine Transportation System (MTS), also referred to as "greening" maritime shipping and ports, as part of longer-term, ambitions of economy wide net-zero GHG emission targets and zero GHG	○ Advance U.S. commitment to achieve the goal of zero emissions from international shipping no later than 2050. ○ Accelerate maritime green shipping corridor development through research and development.

	Ocean Climate Opportunity	OCAP Actions
	emissions from international shipping no later than 2050. • Accelerate research, development, and deployment of alternative green fuels, technologies, vessels, and ports. • Create green shipping corridors - maritime routes that showcase low- and zero emission lifecycle fuels and technologies with the ambition to achieve zero GHG emissions across all aspects of the corridor.	○ Green the Nation's ports by upgrading, modernizing, and decarbonizing port infrastructure and operations. ○ Incentivize and enable the shipping industry to adopt zero-emission fuels and technologies. ○ Revolutionize ship construction to build zero-emission U.S.-flag commercial fleet.
Sequestration of CO_2 in Sub-seabed Geologic Formations	• Advance the knowledge base and capacity for sequestration of captured CO_2 in sub-seabed geologic formations as one avenue to reduce net CO_2 emissions and contribute in a meaningful way to U.S. climate mitigation commitments.	○ Develop a marine geologic sequestration program for the U.S. Outer Continental Shelf. ○ Assess opportunities to harmonize regulatory frameworks for sub-seabed CO_2 sequestration in geologic formations across the marine space. ○ Advance research, monitoring, adaptive management, and development on sub-seabed CO_2 sequestration with transparency throughout.
Marine Carbon Dioxide Removal	• By 2030, build sufficient knowledge about the efficacy and tradeoffs of marine carbon dioxide removal (CDR) and use it to guide deployment decisions. • Develop a robust regulatory framework for research and possible later deployment to protect human health, the marine environment, and potentially affected communities, and ensure safe and effective long-term carbon dioxide removal.	○ Set policy and regulatory standards for marine CDR research and implementation. ○ Implement comprehensive Federal research, scaled testing, and monitoring program for promising marine CDR approaches. ○ Launch a U.S. Marine CDR Initiative. ○ Ensure robust, sustained, and adequate ocean observations (*in situ*, remote sensing) are in place. ○ Develop standards for carbon accounting for marine CDR approaches. ○ Evaluate the environmental and social impacts of marine CDR approaches. ○ Incorporate environmental justice and equity in marine CDR research and implementation.

ACCELERATE NATURE-BASED SOLUTIONS

	Ocean Climate Opportunity	OCAP Actions
Blue Carbon	• Advance the protection, conservation, restoration, and sustainable management of coastal and marine habitats that naturally store carbon ("blue carbon") as a key element of U.S. land and ocean conservation and climate mitigation goals through nature-based solutions. • Include the protection, conservation, and restoration of blue carbon habitats, which also provide social, environmental, and biodiversity benefits, as a priority in coastal resource planning and management decisions.	○ Retain coastal blue carbon, and carbon sequestration and storage as a priority in the America the Beautiful initiative to conserve at least 30 percent of U.S. lands and waters by 2030. ○ Support research and development on initiatives in known blue carbon habitats. ○ Conduct research, exploration, and mapping to determine blue carbon potential of coastal and marine ecosystems. ○ Develop standards for blue carbon management for different coastal and ocean habitats. ○ Prioritize conservation, protection, and enhancement of existing coastal blue carbon wetland habitats, and restoration of degraded or potential blue carbon habitats. ○ Conduct a regional to national research and monitoring program of post-restoration coastal blue carbon habitats. ○ Explore innovative approaches to halting the loss of blue carbon ecosystems and to accelerating their conservation and restoration.
Climate-Adaptive Marine Protected Areas	• Create, strengthen, connect, and expand effective climate-adaptive Marine Protected Areas (MPAs) and other conserved areas. • Promote effective protection, adaptive management, and connected MPA networks to enhance resilience and climate adaptation benefits to ecosystem and habitat health. • Utilize science and knowledge, and invest in research to help ensure that MPAs are effective and climate-adaptive.	○ Create, connect, strengthen, and expand Marine Protected Areas (MPA) and MPA networks while enhancing the connectivity of MPAs with one another as well as onshore and inland conservation and use adaptive management. ○ Promote public engagement, Tribal Consultation, and use of Indigenous Knowledge to advance climate-resilient MPAs. ○ Expand research and development of monitoring and predictive capabilities and climate-responsive adaptive management. ○ Prioritize work with Indigenous, urban and nature-deprived, and underserved communities to meet local and national needs through existing and new MPAs and MPA networks. ○ Maximize the benefits of ocean co-use, by planning and siting non-extractive and non-

	Ocean Climate Opportunity	OCAP Actions
		destructive activities in or near marine protected areas, where appropriate. o Strengthen co-stewardship of lands and waters with Tribal Nations and Indigenous Peoples.

ENHANCE COMMUNITY RESILIENCE TO OCEAN CHANGE

	Opportunity	OCAP Actions
Climate Ready Fisheries, Aquaculture, and Fishing Communities	• Advance and implement climate-informed management of fisheries and aquaculture, and increase the resilience of fishing and other coastal communities.	o Provide marine resource decision makers and other ocean users with the information they need to assess risks and take action to adapt to changing ocean conditions. o Enable Regional Fishery Management Councils, and other bodies with Federal nexus, to incorporate climate-ready approaches and decision-making. o Co-produce and deliver the products, tools, information, services and assistance to support climate-ready fishing and aquaculture communities. o Advance research, technologies, and observation systems to support climate-ready marine resources and communities. o Expand and decarbonize sustainable U.S. aquaculture production to enhance resilience of U.S. and global seafood system to the impacts of climate change. o Identify, protect, and restore ocean and coastal habitats essential to climate-ready fisheries, protected species, and fishing communities. o Explore research and development to advance: a climate-ready fishing fleet and aquaculture operations; the use and effectiveness of obsolete offshore infrastructure for artificial reefs; and the resilience of coral populations and coral reef systems. o Reduce climate threats and improve the resiliency of climate vulnerable protected species, including marine mammals.
Coastal Climate Resilience	• Prepare coastal communities for the impacts of climate change through coastal resilience projects informed by dedicated	o Promote coastal community resilience strategies that are adaptive, equitable, and based on best practices.

	Opportunity	OCAP Actions
	Federal investment in expanding data, products, and information. • Engage with stakeholders to ensure equitable access to climate information products and services and promote nature-based solutions where appropriate.	○ Support demonstration projects on community-driven relocation and decision processes. ○ Expand the range of coastal resilience and restoration project financing mechanisms available to frontline communities. ○ Support transformational resilience investments in coastal habitat restoration, conservation and in coastal community resilience. ○ Expand coastal mapping, monitoring, observational systems, research, and modeling to inform science-based decision-making capabilities and advance use of nature-based solutions. ○ Advance evaluation and adoption of nature-based solutions, such as living shorelines, to build resilience against climate-driven coastal hazards. ○ Expand Federal assistance through voluntary habitat conservation. ○ Enhance community resilience through the National Coastal Resilience Fund. ○ Reduce threats to coastal and Great Lakes ecosystems that are exacerbated by climate change.

ADVANCE OTHER OCAP PRIORITIES

	Ocean Climate Opportunity	OCAP Actions
Support Ocean Research, Observations, Modeling, Forecasting, and Synthesis	• Federal leadership and investment can advance the development and adoption of new, low-emission and green technologies for ocean observations.	○ Prioritize Federal ocean research and monitoring specific to the OCAP themes. ○ Support formal and ongoing mechanisms for engaging multi-sectoral representatives. ○ Maintain and expand ocean basic and applied research, observing networks, modeling, forecasting, synthesis, and technology development. ○ Identify opportunities to co-locate ocean climate solution activities. ○ Develop new and innovative technologies and information pathways for ocean climate action.

	Ocean Climate Opportunity	OCAP Actions
Address Ocean Acidification	• Global solutions for ocean acidification require rapidly stabilizing and reducing atmospheric CO_2 levels. • Some nature-based ocean climate actions also can contribute to local-scale ocean acidification reduction by taking up excess CO_2 from seawater and enhancing ecosystem resilience.	○ Accelerate research and monitoring on ocean acidification. ○ Expand engagement with US coastal communities vulnerable to ocean acidification, especially Tribal communities. ○ Create a U.S. Ocean Acidification Action Plan. ○ Continue to raise awareness about ocean acidification as a significant problem for marine life, fisheries and aquaculture, and a sustainable ocean economy, and seek international partnerships to address the problem. ○ Ensure that ocean acidification and its impacts are included in discussions of potential geoengineering approaches.

Cross-cutting Principles and Actions

The Biden-Harris Administration is committed to grounding ocean climate action in science, evidence, and knowledge, developing policies that reflect the needs and ideas of impacted communities, and implementing actions in ways that are equitable, timely, and holistic. The following cross-cutting principles and actions will ensure that agencies continue to advance the Biden-Harris Administration's commitment to equity, justice, engagement, and meaningful participation in Federal decision making by integrating knowledge, engagement, and implementation across all of the ocean climate action themes included in the OCAP.

Ocean Health and Stewardship: The OCAP describes actions to increase the ocean's capacity to reduce climate-change causing emissions and address the climate crisis. Stewardship, conservation, and protection of the ocean's existing natural resilience are fundamental. For the Biden-Harris Administration, a *healthy and resilient* ocean is the foundation of climate action, and the OPC and member agencies affirm its importance. When developing and deploying ocean climate actions, Federal agencies should be guided by the precautionary approach in order to minimize unintended consequences to ocean health and ecosystem functioning. In addition to the ocean's value as a climate solution, the OCAP and related public-facing documents emphasize the inherent value of healthy and resilient ocean ecosystems. **The OPC will include a focus on ocean health and stewardship in all of its activities.**

Environmental Justice: The Biden-Harris Administration is committed to ensuring that the perspectives and lived experiences of environmental justice communities are reflected in Federal Government actions. This commitment is reflected in the Justice40 Initiative, which works to provide 40% of the overall benefits of Federal investment in particular programs, including investment in climate change and clean energy, to disadvantaged communities.[38] When implementing the OCAP, agencies will incorporate environmental justice principles. Additionally, the Administration reaffirms the importance of minimizing the impacts of ocean climate action to communities that already face disproportionate burdens. **To support this work, the OPC will develop an Ocean Justice Strategy that will identify barriers and opportunities to fully integrate environmental justice principles into the Federal Government's ocean activities.**

Engage with Tribal Nations and Indigenous Peoples: The Biden-Harris Administration recognizes that Tribal Nations and Indigenous Peoples, including Native Americans, Alaska Natives, Native Hawaiians, and Indigenous Peoples of the U.S. Territories, bring unique expertise in protecting ecosystems and developing solutions to the climate crisis. The Administration also acknowledges that Tribal Nations and Indigenous Peoples are on the front lines of climate change, and that global and localized changes to our ocean ecosystems can create food sovereignty challenges and crises for all place-based peoples. Climate adaptation raises important questions about how the United States upholds treaty rights and trust responsibilities to Tribal Nations and Indigenous Peoples. The Administration is committed to strengthening Nation-to-Nation relationships through formal consultation with Tribal Nations. The Administration also is committed to engaging with Tribal Nations outside of formal consultation, as

[38] The White House. Justice40. https://www.whitehouse.gov/environmentaljustice/justice40/. Last accessed March 2023. ("A 'covered program' is a Federal Government program that falls in the scope of the Justice40 initiative because it includes investments that can benefit disadvantaged communities across one or more of the following seven areas: climate change, clean energy and energy efficiency, clean transit, affordable and sustainable housing, training and workforce development, remediation and reduction of legacy pollution, and the development of critical clean water and wastewater infrastructure.").

well as engaging with Indigenous Peoples and considering, including, and applying Indigenous Knowledge in Federal decisions, including decisions about the ocean, as appropriate, following the principles set forth in recent Federal guidance on Indigenous Knowledge outlined in the Memorandum on Uniform Standards for Tribal Consultation.[39] Departments and agencies re-affirm the importance both of following the latest best practices for Tribal Consultation with Tribal Nations and of upholding Indigenous Knowledge as an important contribution to the scientific, technical, social, and economic advancements of the United States and to our collective understanding of the natural world[40]. **The OPC and its member agencies commit to early, frequent, and meaningful engagement with Tribal Nations, including through formal Nation-to-Nation Tribal Consultation, and other engagement with Indigenous Peoples, on the actions that stem from the OCAP. The Administration will consider Indigenous Knowledge in advancing actions based on the OCAP and will explore innovative funding mechanisms, technical assistance and other means to improve access to Federal funds for Tribal Nations and Indigenous Peoples, including for research, monitoring, and workforce development.**

Outreach and Engagement: The Federal Government cannot address the climate crisis alone. Federal agency actions will be guided by the acknowledgement that equitable policy requires the frequent and early involvement of those who will be affected by decision making. In implementing the actions outlined in the OCAP, agencies commit to redoubling their efforts to notify, engage, and communicate with local communities, following existing best practices. **The OPC will establish a mechanism for engaging Federal, Tribal, State, and Territorial agencies, the private sector, academia, non-governmental organizations (NGOs), and the public – to support participation in OPC initiatives, in partnership with the National Oceanographic Partnership Program, the Ocean Research Advisory Panel, and the National Ocean Mapping, Exploration, and Characterization Council, and other relevant Federal bodies, as appropriate.**

Science, Evidence, and Knowledge: The actions presented in this plan are grounded in the evidence and sound science, in keeping with the Biden-Harris Administration's commitment to Restoring Trust in Government Through Scientific Integrity and Evidence-Based Policymaking,[41] [42] [43] and following public access policies to make the products and process of Federally-funded research freely available, without an embargo or cost. The priority actions in the OCAP are those for which there is substantial evidence that action will lead to climate benefits, while also minimizing unintended consequences to people and the environment. In some cases, the knowledge required to evaluate particular actions is emerging, and the OCAP calls for additional research, development and demonstration to close knowledge gaps and determine the effectiveness of particular actions prior to full-scale implementation. Consistent with the

[39] The White House, Memorandum on Uniform Standards for Tribal Consultation. (Nov. 30, 2022). https://www.whitehouse.gov/briefing-room/presidential-actions/2022/11/30/memorandum-on-uniform-standards-for-tribal-consultation/.
[40] Arati Prabhakar, Assistant to the President and Director, Office of Science and Technology Policy, & Brenda Mallory, Chair, Council on Environmental Quality. (2022). Memorandum for Heads of Federal Departments and Agencies, Guidance for Federal Departments and Agencies on Indigenous Knowledge. https://www.whitehouse.gov/wp-content/uploads/2022/12/OSTP-CEQ-IK-Guidance.pdf.
[41] The White House. Presidential Memorandum, Restoring Trust in Government Through Scientific Integrity and Evidence-Based Policymaking (Jan. 27, 2021). https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/27/memorandum-on-restoring-trust-in-government-through-scientific-integrity-and-evidence-based-policymaking/ .
[42] The White House, Protecting the Integrity of Government Science, Report from the National Science and Technology Council, January 2022. https://www.whitehouse.gov/wp-content/uploads/2022/01/01-22-Protecting_the_Integrity_of_Government_Science.pdf.
[43] The White House. (2023). A Framework for Federal Scientific Integrity Policy and Practice, Report from the National Science and Technology Council. https://www.whitehouse.gov/wp-content/uploads/2023/01/01-2023-Framework-for-Federal-Scientific-Integrity-Policy-and-Practice.pdf.

Biden-Harris Administration's commitment to consider, include, and apply Indigenous Knowledge in Federal decision-making, [44] [45] the OCAP looks to partnerships to help achieve that goal. **Building on the Administration's ocean science, technology and knowledge priorities, the OPC's Subcommittee on Ocean Science and Technology will develop recommendations for Federal research priorities specific to the OCAP themes to help guide Federal, academic, and private sector research and engagement.**

Interagency Coordination: Climate change crosses scientific disciplines, geographic boundaries, cultural perspectives, and socioeconomic lines. Given the role that the ocean plays in influencing weather and climate, enabling global trade and communications, and providing important sources of food and opportunities for recreation and solace, communities across the Nation are dependent on what happens in the ocean regardless of their distance from the coasts. Ocean-based solutions to the climate crisis must be comprehensive and coordinated across historical disciplinary and geographic silos. Accordingly, these solutions rarely fit within the mission of a single Federal department or agency. **Successful development and implementation of ocean climate actions will require integrated and coordinated action across the Federal Government – such as that provided by the OPC – and in partnership with Tribal Nations, Indigenous Peoples, States, U.S. Territories, communities, the private sector, and civil society.**

[44] The White House. (2022). Guidance for Federal Departments and Agencies on Indigenous Knowledge, Memorandum from OSTP and CEQ. https://www.whitehouse.gov/wp-content/uploads/2022/12/OSTP-CEQ-IK-Guidance.pdf.

[45] The White House (2022). Implementation of Guidance for Federal Departments and Agencies on Indigenous Knowledge, Memorandum from OSTP and CEQ. https://www.whitehouse.gov/wp-content/uploads/2022/12/IK-Guidance-Implementation-Memo.pdf.

OCAP Priority: Support Ocean Research, Observations, Modeling, Forecasting and Synthesis

Advancing ocean climate action requires robust and sustained ocean and climate science.[46] Science informs what to prepare for and adapt to, guides evaluation of efficacy of previous or existing options, and helps us measure whether what we are doing reduces our risk and increases our resilience. Examples of important scientific information that informs ocean climate action include: observations and monitoring; field and laboratory testing; modeling and forecasting; ocean mapping, exploration, and characterization;[47] technology development; synthesis and assessment; and adaptive management.

In many cases, **research on ocean-based climate solutions has moved beyond the laboratory, and the next steps involve field testing and experimentation in the ocean at appropriate scales and conditions. Pilot and demonstration-scale projects, as well as large-scale deployments, will need to be appropriately regulated and permitted under the existing regulatory structure to ensure that appropriate monitoring and evaluation is designed and conducted for these projects and that unintended adverse impacts are avoided. Opportunities for leveraging common resources and reducing barriers between disciplines will advance progress across multiple research fronts.** Research challenges include sustaining high-quality observations to underpin and inform forecasting and address climate-related knowledge gaps. Improving observations may require the advancement of instrumentation, power, data-transfer and accessibility infrastructure, as well as leveraging existing technology and systems to support measuring, monitoring, reporting, and verification (MMRV) and adaptive management. There are opportunities to efficiently use single platforms or integrated ocean research sites from which to study offshore wind, marine energy, marine carbon dioxide removal (marine CDR), and sustainable aquaculture. An illustrative model is PacWave, a first-of-its-kind, U.S. Department of Energy (DOE)-funded, grid-connected, full-scale test facility for wave energy conversion technologies.[48] As part of the UN Decade of the Ocean for Sustainable Development, the National Academies of Sciences, Engineering and Medicine (NASEM) has identified a number of priority areas where transformational research is required to significantly advance ocean sustainability and climate solutions, including testing solutions at scale. [49]

Federal leadership and investment can also advance the development and adoption of new, low-emission and green technologies for ocean observations. Federal, State, and academic oceanographic research communities are already pioneering novel autonomous platforms, sensors, and remote sensing technologies. Partnerships with industry and international entities, such as ships of opportunity and investments in research towards a cleaner ocean, can significantly expand current scientific capabilities. Smart use of marine energy sources can power ocean observations, and design efforts are underway for low-emission research vessels.

[46] NOAA. (2022). Ocean Policy Committee 2022 Action Plan. https://www.noaa.gov/sites/default/files/2022-06/OPC2022ActionPlanSummary.pdf. https://www.noaa.gov/sites/default/files/2022-06/OPC2022ActionPlanSummary.pdf.
[47] Ocean Science and Technology Subcommittee, Ocean Policy Committee. (2020), National Strategy for Mapping, Exploring, and Characterizing the United States Exclusive Economic Zone. https://www.noaa.gov/sites/default/files/2022-07/NOMECStrategy.pdf.
[48] DOE Water Power Technologies Office. PacWave. https://www.energy.gov/eere/water/pacwave. Last accessed March 2023.
[49] National Academies of Sciences, Engineering, and Medicine. (2022). Cross-Cutting Themes for U.S. Contributions to the UN Ocean Decade. https://nap.nationalacademies.org/catalog/26363/cross-cutting-themes-for-us-contributions-to-the-un-ocean-decade.

Further Action: Below is a summary of the actions that Departments and agencies can take to support ocean research, observations, modeling, forecasting and synthesis. For expanded details on these actions, please see the Appendix, which also lists responsible agencies and projected timelines.

- **Prioritize Federal ocean research specific to the OCAP themes** to help guide Federal, academic, and private sector research and engagement.
- **Support formal and ongoing mechanisms for engaging multi-sectoral representatives** – including Federal, Tribal, State and Territorial agencies, the private sector, academia, NGOs, regional organizations, and the public – to facilitate participation in government-wide ocean science initiatives.
- **Maintain and expand ocean basic and applied research, observing networks, modeling, forecasting, synthesis, and technology development** to support and advance ocean climate solutions.
- **Identify opportunities to co-locate ocean climate solution activities** at targeted locations to leverage common resources and reduce barriers for ocean solution research and evaluation.
- **Develop new and innovative technologies and information pathways for ocean climate action** by tapping into diverse expertise and perspectives.

CREATE A CARBON-NEUTRAL FUTURE

The first set of ocean climate actions—offshore wind energy and marine energy from in-water sources, green maritime shipping, and capturing and storing carbon dioxide (CO_2) in the ocean and sub-seabed—help achieve a carbon-neutral future where CO_2 and other greenhouse gas emissions are sharply reduced and any remaining emissions are offset by CO_2 sequestration (otherwise known as net-zero CO_2 emissions). These actions fall under the category of *climate mitigation*. The phrase "carbon-neutral" in this document is shorthand and should be understood as inclusive of all greenhouse gases.

Offshore Wind and Marine Energy

Objective: Meet the Biden-Harris Administration's goal to deploy 30 GW of offshore wind by 2030, 15 GW of floating offshore wind by 2035,[50] [51] and to rapidly and responsibly advance the commercialization of marine energy technologies that convert energy from waves, tides, currents, and other ocean sources. Expand offshore wind and marine energy as an alternative to higher-emitting energy resources in order to meet the Administration's broader goal to reach 100 percent carbon pollution-free electricity by 2035 and net-zero greenhouse gas emissions economy-wide by no later than 2050.[52]

Background: Ocean renewable energy sources can support grid and economy-wide decarbonization. Of ocean renewable energy sources, offshore wind is the most mature, and U.S. resources are abundant.[53] **Offshore wind potential exists for over 4,000 GW of capacity off U.S. coasts and in the Great Lakes—more than three times the country's installed electricity generation capacity**.[54] Waters off the U.S. Territories offer additional promise.[55] Deploying offshore wind at scale will take significant investment in port and supply chain infrastructure in coastal communities, and a large and skilled workforce, which will create tens of thousands of new American jobs in offshore wind and adjacent sectors, and offer new and exciting opportunities for these communities.[56]

The ocean also presents significant opportunities to harness marine energy: wave energy, tidal energy, energy derived from ocean currents, and energy derived from salinity, pressure, and temperature gradients. **Total available marine energy in the United States is equivalent to approximately 57%**

[50] The Biden-Harris Administration offshore wind goals do not apply to the Great Lakes, where the authority to develop offshore wind capacity lies with the Great Lakes States.
[51] The White House. Biden-Harris Administration Announces New Actions to Expand U.S. Offshore Wind Energy https://www.whitehouse.gov/briefing-room/statements-releases/2022/09/15/fact-sheet-biden-harris-administration-announces-new-actions-to-expand-u-s-offshore-wind-energy/. Last accessed March 2023.
[52] The White House, FACT SHEET: President Biden Sets 2030 Greenhouse Gas Pollution Reduction Target Aimed at Creating Good-Paying Jobs and Securing U.S. Leadership on Clean Energy Technologies (April 22, 2021), https://www.whitehouse.gov/briefing-room/statements-releases/2021/04/22/fact-sheet-president-biden-sets-2030-greenhouse-gas-pollution-reduction-target-aimed-at-creating-good-paying-union-jobs-and-securing-u-s-leadership-on-clean-energy-technologies/. Last accessed March 2023.
[53] DOE Wind Energy Technologies Office. (2022). Offshore Wind Market Report: 2022 Edition. https://www.energy.gov/eere/wind/articles/offshore-wind-market-report-2022-edition .
[54] Lopez, A. Green, R. Williams, T. et al. (2022). Offshore Wind Energy Technical Potential for the Contiguous United States. https://www.nrel.gov/docs/fy22osti/83650.pdf.
[55] DOE Office of Energy Efficiency & Renewable Energy. Offshore Wind Research and Development. https://www.energy.gov/eere/wind/offshore-wind-research-and-development. Last accessed March 2023.
[56] The White House. FACT SHEET: Biden Administration Jumpstarts Offshore Wind Energy Projects to Create Jobs. https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/29/fact-sheet-biden-administration-jumpstarts-offshore-wind-energy-projects-to-create-jobs/. Last accessed March 2023.

of all U.S. electrical power generation in 2019.[57] Even if only a small portion of this resource potential is captured, marine energy technologies would make significant contributions to the nation's energy needs. In the short term, marine energy could serve U.S. coastal communities and provide local, clean power to rural and remote island communities, which often rely on expensive shipments of fossil fuels. Marine energy technologies can also power offshore work and the sustainable ocean economy. These technologies could help power important ocean observational systems to predict destructive storms, measure ocean health, provide clean water in disaster relief scenarios, and power food- and water-production systems. In the longer term, marine energy can also play a big role in decarbonizing the country's power grid.

Challenges: **While the United States is making great strides in offshore wind development, there are still key opportunities to fully seize the climate, economic, and public health benefits of this clean energy resource, while also advancing complementary goals and improving the co-use of ocean spaces.** We are at a critical nexus in developing and planning for offshore wind development and transmission. Coordination across Federal, State, U.S. Territories, local government, and with Tribal Nations, the fishing and wind industries, and other key players for permitting, grid planning, infrastructure (including ports), supply chain development (including vessels and other components), and workforce development, will be necessary to further propel the progress of the offshore wind sector and meet the Administration's goals. Responsible development of offshore wind will incorporate robust environmental and socioeconomic review process and consideration of the needs of all users of coasts and ocean waters. Further, in the United States the challenges facing the development of fixed-bottom versus floating offshore wind energy are distinct. Fixed-bottom technologies are suited for deployment in shallow ocean waters and are more commercially mature. Floating technologies, which allow for development of offshore wind in waters greater than 60 meters in depth and involve floating platforms tethered to the sea floor, are at an earlier stage of deployment internationally and domestically, and are currently more expensive than fixed-bottom technologies. Research and development to lower the costs of both these technologies and address unique market conditions is critical to increase the scale of future development.

Sources of marine energy share challenges with offshore wind — including permitting and licensing processes — as well as their own challenges: lower technology readiness, higher cost, and barriers to testing since only a few facilities can accurately evaluate devices both on land and offshore. Additionally, marine energy can be a challenging resource to harness: salt water and sediment could damage ocean-bound machines; devices must be able to withstand strong wave and tidal conditions; and deploying or servicing devices offshore can be costly in terms of time and money. To overcome these barriers, **critical research and development focused on cost reduction and creating tough, robust machines is needed to help marine energy advance toward commercialization**.

[57] Kilcher, L. Fogarty, M. Lawson, M. (2021). Marine Energy in the United States: An Overview of Opportunities. https://www.energy.gov/eere/water/downloads/marine-energy-united-states-overview-opportunities.

Progress: The Biden-Harris Administration set bold goals to deploy 30 GW of offshore wind by 2030 and 15 GW of floating offshore wind by 2035.[58] Achieving these targets will unlock a pathway to 110 GW or more by 2050.[59] The Administration has already:

- Approved the Nation's first two major offshore wind projects, Vineyard Wind[60] and South Fork Wind,[61] both now under construction and being built by union labor. The Administration is on track to review at least 16 plans for projects representing 27 GW of clean energy potential by 2025.
- Held historic lease sales in the New York Bight,[62] Carolina Long Bay,[63] and California,[64] with new incentives for bidders to support workforce training, supply chain development, and local community benefits;
- Advanced additional wind energy areas on other coastlines, in order to hold potential lease sales in the Gulf of Mexico, the Mid-Atlantic, offshore Oregon, and the Gulf of Maine by 2025;[65]
- Established a Federal-State Offshore Wind Implementation Partnership with Governors and the support of the Departments of the Interior, Energy, Commerce, and Transportation;[66]
- Launched a Floating Offshore Wind Shot™ to advance U.S. leadership in floating offshore wind design, manufacturing, and deployment, with an ambitious target to reduce costs at least 70% by 2035, to $45 per megawatt-hour for deep sites far from shore;[67]
- Strengthened interagency collaboration on advancing offshore wind, while protecting biodiversity and promoting ocean co-use, including through the Biden-Harris Administration Permitting Action Plan[68] and an MOU between the Bureau of Ocean and Energy Management

[58] The White House. FACT SHEET: Biden-Harris Administration Announces New Actions to Expand U.S. Offshore Wind Energy. (September 15, 2022). https://www.whitehouse.gov/briefing-room/statements-releases/2022/09/15/fact-sheet-biden-harris-administration-announces-new-actions-to-expand-u-s-offshore-wind-energy/. Last accessed March 2023.

[59] The White House. Fact Sheet: Biden Administration Jumpstarts Offshore Wind Energy Projects to Create Jobs. (March 29, 2021). (https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/29/fact-sheet-biden-administration-jumpstarts-offshore-wind-energy-projects-to-create-jobs/. Last accessed March 2023.

[60] U.S Department of the Interior, Biden-Harris Administration Approves First Major Offshore Wind Project in U.S. Waters (May 11, 2021), https://www.doi.gov/pressreleases/biden-harris-administration-approves-first-major-offshore-wind-project-us-waters. Last accessed March 2023.

[61] U.S Department of the Interior, Share Interior Department Approves Second Major Offshore Wind Project in U.S. Federal Waters (November 24, 2021), https://www.doi.gov/pressreleases/interior-department-approves-second-major-offshore-wind-project-us-federal-waters/. Last accessed March 2023.

[62] U.S Department of the Interior, Biden-Harris Administration Sets Offshore Energy Records with $4.37 Billion in Winning Bids for Wind Sale (February 25, 2022), https://www.doi.gov/pressreleases/biden-harris-administration-sets-offshore-energy-records-437-billion-winning-bids-wind. Last accessed March 2023.

[63] U.S Department of the Interior, Biden-Harris Administration Announces Winners of Carolina Long Bay Offshore Wind Energy Auction (May 11, 2022), https://www.doi.gov/pressreleases/biden-harris-administration-announces-winners-carolina-long-bay-offshore-wind-energy. Last accessed March 2023.

[64] U.S Department of the Interior, Biden-Harris Administration Announces Winners of California Offshore Wind Energy Auction (December 7, 2022), https://doi.gov/pressreleases/biden-harris-administration-announces-winners-california-offshore-wind-energy-auction. Last accessed March 2023.

[65] Bureau of Ocean Energy Management, Offshore Wind Leasing Path Forward 2021- 2025 (October 2021), https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/OSW-Proposed-Leasing-Schedule.pdf. Last accessed March 2023.

[66] The White House, FACT SHEET: Biden Administration Launches New Federal-State Offshore Wind Partnership to Grow American-Made Clean Energy (June 23, 2022), https://www.whitehouse.gov/briefing-room/statements-releases/2022/06/23/fact-sheet-biden-administration-launches-new-federal-state-offshore-wind-partnership-to-grow-american-made-clean-energy/. Last accessed March 2023.

[67] Cost reduction is compared to current estimates of potential costs. DOE Office of Energy Efficiency & Renewable Energy. Floating Offshore Wind Shot. https://www.energy.gov/eere/wind/floating-offshore-wind-shot. Last accessed March 2023.

[68] The White House, FACT SHEET: Biden-Harris Administration Releases Permitting Action Plan to Accelerate and Deliver Infrastructure Projects On Time, On Task, and On Budget (May 11, 2022),)https://www.whitehouse.gov/briefing-room/statements-releases/2022/05/11/fact-sheet-biden-harris-administration-releases-permitting-action-plan-to-accelerate-and-deliver-infrastructure-projects-on-time-on-task-and-on-budget/. Last accessed March 2023.

(BOEM) and the National Oceanic and Atmospheric Administration (NOAA),[69] and by establishing an Offshore Wind Interagency Working Group (OW-IWG).

- The OW-IWG is strengthening the domestic supply chain and smart transmission planning; improving collaboration with Tribal Nations, States, regional transmission operators, developers, ocean users, and other stakeholders to identify near-, medium-, and long-term offshore wind transmission challenges and associated action plans to address them.
- The Department of the Interior (DOI) proposed regulatory reforms in January 2023 to reduce administrative burdens for both developers and DOI, reduce developer costs and uncertainty, and introduce greater regulatory flexibility while maintaining environmental safeguards. The proposed rule is a major modernization of the BOEM renewable energy regulations, reflects lessons learned from the past 13 years, and is projected to save the renewable energy industry $1 billion over 20 years.[70]

The Biden-Harris Administration has also secured historic new investments in offshore wind.[71] The IRA provides a suite of tax credits that support project developers and manufacturers, and $100 million for interregional and offshore wind energy transmission development. The IRA brings opportunities to new regions by ending the 2020 leasing moratorium on offshore wind development off the coasts of Florida, Georgia, South Carolina, and North Carolina, and allowing for potential development along U.S. Territories following consultations with the Governors of American Samoa, the Commonwealth of the Northern Mariana Islands, Guam, Puerto Rico, and the U.S. Virgin Islands.[72] The Biden-Harris Administration is harnessing resources from the BIL, including a recent round of U.S. Department of Transportation (DOT) port funding (nearly $100 million of which will indirectly support offshore wind supply chains).[73] The BIL also allocates $3.9 billion to the U.S. Army Corps of Engineers (USACE) for port and waterway improvements, including key supply chain related projects,[74] and funds the U.S. Department of Energy (DOE) to support research and development for a range of offshore wind priorities.[75]

Marine energy has also received historic new investment from the Biden-Harris Administration. Marine energy is a growing industry in the United States and abroad. Technologies for wave, tidal, current, and thermal energy generation are still under development, and no one form of marine energy has proven to be the most efficient or cost-effective. In general, these technologies are still in the relatively early stages of development and have not been tested for commercial-scale energy generation, though the

[69] NOAA. NOAA and BOEM announce interagency collaboration to advance offshore wind energy (January 12, 2022), https://www.noaa.gov/news-release/noaa-and-boem-announce-interagency-collaboration-to-advance-offshore-wind-energy. Last accessed March 2023.

[70] Renewable Energy Modernization Rule, 30 CFR 585, Docket BOEM-2023-0005-0001, January 30, 2023.

[71] "H.R.812 - 118th Congress (2023-2024): Inflation Reduction Act of 2023." Congress.gov, Library of Congress, 3 February 2023, https://www.congress.gov/bill/118th-congress/house-bill/812.

[72] "H.R.812 - 118th Congress (2023-2024): Inflation Reduction Act of 2023." Congress.gov, Library of Congress, 3 February 2023, https://www.congress.gov/bill/118th-congress/house-bill/812.

[73] U.S Department of Transportation Maritime Administration. Biden-Harris Administration Announces More Than $703 Million to Improve Port Infrastructure, Strengthen National Supply Chains, Lower Costs (October 28, 2022), https://www.maritime.dot.gov/newsroom/biden-harris-administration-announces-more-703-million-improve-port-infrastructure. Last accessed March 2023.

[74] The White House. FACT SHEET: Biden-Harris Administration Announces Additional Infrastructure Funding for Ports and Waterways. (March 29, 2022). https://www.energy.gov/articles/biden-harris-administration-announces-30-million-bipartisan-infrastructure-law-speed-wind. Last accessed March 2023.

[75] U.S Department of Energy. Biden-Harris Administration Announces $30 Million from Bipartisan Infrastructure Law to Speed Up Wind Energy Deployment (October 18, 2022), https://www.energy.gov/articles/biden-harris-administration-announces-30-million-bipartisan-infrastructure-law-speed-wind. Last accessed March 2023.

resource potential is immense and widely distributed.[76] [77] Companies are successfully deploying prototypes, offering a peek into the significant potential of this industry. A record $110.4 million dollars was included in BIL funding for marine energy research and development projects as well as continued investment in National Marine Energy Centers, a network that has become internationally recognized for their marine energy research and testing expertise.[78] Under this Administration, marine energy technology development has reached new milestones, including the longest running demonstrations in history for both wave energy and tidal energy.[79] Additionally, the previously-mentioned IRA tax credits for offshore wind can also be applied to the development of marine energy technologies in our nation. This administration values innovative clean energy solutions and has included continues investment for R&D in annual appropriations to DOE for marine energy. **Investing in research and development for marine energy will advance innovative energy systems in the United States and contribute to a flexible, reliable power grid.**

OCAP Actions: Below is a summary of the Offshore Wind and Marine Energy OCAP Actions. For expanded details on these OCAP Actions, please see the Appendix, which lists responsible departments and agencies and projected timelines. These actions reflect a subset of broader efforts underway across Federal agencies, coordinated by the White House Climate Policy Office, with support from across the Executive Office of the President.

- **Expand offshore wind and marine energy in an environmentally responsible manner that considers the needs of all users of those lands, coasts, and waters** by publishing an Offshore Wind Leasing Schedule with clear timelines;[80] ensuring a robust environmental and socioeconomic review process through expanded research and data sharing; using the best-available science to assess how climate change may affect the relevant affected environment and proposed offshore wind development including, for instance, by using available climate models to assess projected changes to wind or weather patterns;[81] fast tracking reforms and rulemaking to facilitate timely and responsible development of ocean renewable energy resources on the Outer Continental Shelf (OCS); mitigating offshore wind turbine interference to radar systems; identifying gaps in ocean mapping data requirements; and advancing scientific research and knowledge on the potential impacts on ocean and coastal resources, habitats and observing systems. Key agencies: DOI/BOEM/BSEE, CEQ, DOE, FPISC, NOAA, USCG, USACE
- **Address transmission challenges to facilitate the United States achieving its offshore wind targets** by studying and addressing onshore transmission constraints; developing standards

[76] Kilcher, L. Fogarty, M. Lawson, M. (2021). Marine Energy in the United States: An Overview of Opportunities. https://www.energy.gov/eere/water/downloads/marine-energy-united-states-overview-opportunities.
[77] Almeidia, R. Schmitt, R. Grodsky, S. et al. (2022). Floating solar power could help fight climate change — let's get it right. *Nature.* https://doi.org/10.1038/d41586-022-01525-1.
[78] Water Power Technologies Office, Office of Energy Efficiency & Renewable Energy, Department of Energy. How the Bipartisan Infrastructure Law Will Energize America With Water Power. (June 22, 2022). https://www.energy.gov/eere/water/articles/how-bipartisan-infrastructure-law-will-energize-america-water-power. Last accessed March 2023.
[79] Water Power Technologies Office, Office of Energy Efficiency & Renewable Energy, Department of Energy. CalWave Launches California's First Long-Term Wave Energy Project. (March 28, 2022). https://www.energy.gov/eere/water/articles/calwave-launches-californias-first-long-term-wave-energy-project. Last accessed March 2023.
[80] Bureau of Ocean Energy Management, Offshore Wind Leasing Path Forward 2021- 2025 (October 2021), https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/OSW-Proposed-Leasing-Schedule.pdf. Last accessed March 2023.
[81] Consistent with the Council on Environmental Quality's January 2023 *Interim NEPA Guidance on Greenhouse Gas Emissions and Climate Change*, available at: https://www.federalregister.gov/d/2023-00158.

and policy; fostering comprehensive transmission planning, both onshore and as part of marine spatial planning; and implementing intra-regional and inter-regional transmission solutions. Key agencies: BOEM, DOE, FERC

- **Support innovation in offshore wind and marine energy technologies by expanding research and development** for resource characterization, next-generation technology design, and new materials; real-condition testing of these technologies; performance and reliability optimization; socioeconomic impacts; and repurposing obsolete offshore oil and gas infrastructure. Key agencies: DOE, DOI/BOEM/BSEE
- **Improve ports, U.S. ships, and domestic supply chains to facilitate offshore wind deployment** by incentivizing production of U.S. wind turbine installation vessels and other needed offshore wind support vessels, as well as upgrading port infrastructure to meet the increasing offshore wind industry needs. Key agencies: BOEM, DOE, DOT, USACE
- **Foster partnerships focused on training the workforce needed to rapidly expand and maintain offshore wind energy and marine energy development** in order to meet the growing needs of these sectors, and recruit workforce participants from historically marginalized communities and coastal regions. Key agencies: DOE, DOT, NOAA
- **Investigate the potential of offshore wind and marine energy to power applications in and beyond the sustainable ocean economy** by advancing coupled wind or marine energy-storage to allow for wide-spread adoption, extended use cases and performance in different power markets; and production and storage of climate-neutral green hydrogen and other clean fuels to electrify various sectors of the economy, including the Marine Transportation System (MTS). Key agencies: DOE, BOEM, DOT
- **Facilitate the responsible deployment of offshore wind** globally by identifying knowledge gaps on impacts to the marine environment, building capacity in local and underserved communities, including working closely with Tribes, and coordinating with other ocean industries to advance multiple ocean co-uses, and minimize trade-offs with offshore wind; and through engagement with governments, private sector, and international organizations such as the Global Offshore Wind Alliance, the International Renewable Energy Agency, and the Global Offshore Wind Regulators Forum, which are forums that facilitate the exchange of lessons learned and best practices to support responsible deployment both globally and domestically. Key Agencies: DOI/BOEM/BSEE, NOAA, State

Green Maritime Shipping

Objective: Advance the decarbonization of the U.S. Marine Transportation System (MTS), also referred to as "greening" maritime shipping and ports, as part of longer-term, ambitions of economy wide net-zero GHG emission targets and zero GHG emissions from international shipping no later than 2050.[82] Accelerate research, development, and deployment of low- and zero-emission lifecycle fuels and technologies, a revolution in ship construction for engine and vessel technology supporting alternative and dual fuels, greening of U.S. ports, creation of green shipping corridors (maritime routes that showcase low- and zero emission lifecycle fuels and technologies with the ambition to achieve zero GHG emissions across all aspects of the corridor), and continue strong engagement with industry and international partners.

Background: The MTS, including vessels and ports, is the primary system by which goods enter and leave the United States.[83] The MTS touches virtually every aspect of American life – the clothes we wear, the cars and trucks we drive, the food we eat, and the oil and natural gas used to heat and cool our homes.[84] The MTS is a key sector for meeting the international goal of limiting global temperature rise to 2 degrees Celsius (2°C) above pre-Industrial levels, while pursuing efforts to limit the increase even further to 1.5°C; if international maritime transportation system were a "country," it would be one of the largest GHG emitters. By 2050, emissions from the sector are projected to increase by up to 50% from 2018 levels under a business-as-usual scenario.[85]

Green maritime shipping will require vessels to use low- and zero-GHG emission lifecycle fuels and technologies that are in development with some approaches already being tested and deployed. Similarly, electrification, optimization, and more energy-efficient port operations can greatly reduce or, in combination, may eliminate shoreside GHG emissions. Accelerating the decarbonization of the MTS will also serve to improve air and water quality in often vulnerable coastal and port communities, and generate health and environmental justice co-benefits through reducing criteria pollutant emissions near these communities.[86] As next-generation infrastructure is envisioned and built, there is an opportunity to link new renewable energy sources directly to ports, contributing to a systems-approach to climate action. Increased port operations associated with offshore wind energy development can be mitigated by building towards landside operations (cargo-handling equipment, trucks/locomotives transporting supplies to the port, etc.) that operate with low- or zero-emissions technology. The MTS employs hundreds of thousands of people within the country, and many more throughout the globe. Modernizing the MTS through a climate lens is an opportunity to educate and train a larger and more diverse MTS workforce.

Challenges: Achieving zero GHG emissions from international shipping over the coming years and decades will require research, technology development, demonstration, and deployment at a massive scale, as well as enabling policies that incentivize the shift to low- and zero-emission fuels and

[82] The White House, President Biden's Leaders' Summit on Climate https://www.whitehouse.gov/briefing-room/statements-releases/2021/04/23/fact-sheet-president-bidens-leaders-summit-on-climate/. Last Accessed March 2023.
[83] U.S. Committee on the Marine Transportation System, "An Assessment of the U.S. Marine Transportation System: A Report to Congress, Washington, DC. March 28, 2022, https://rosap.ntl.bts.gov/view/dot/61440. Last accessed March 2023.
[84] Ibid.
[85] International Maritime Organization. Fourth Greenhouse Gas Study 2020. https://www.imo.org/en/OurWork/Environment/Pages/Fourth-IMO-Greenhouse-Gas-Study-2020.aspx. Last accessed March 2023.
[86] Pacific Northwest National Laboratory. Maritime Decarbonization. https://www.pnnl.gov/explainer-articles/maritime-decarbonization. Last accessed March 2023.

technologies as soon as possible. Adoption of these fuels and technologies is currently limited and must accelerate rapidly in conjunction with establishment of domestic and international supply chains consistent with governmental and sectoral statements on their intent for energy transition.

Progress: The Biden-Harris Administration has already committed to working with countries in the International Maritime Organization to adopt a goal of zero GHG emissions from international shipping no later than 2050.[87] The United States has also co-launched the Zero-Emission Shipping Mission to accelerate public-private collaboration. At the 26th United Nations Climate Change Conference (COP26), the United States joined partners on shipping declarations, including the Declaration on Zero-Emission Shipping and the Clydebank Declaration to establish green shipping corridors.[88] COP27 furthered these shipping commitments through the launch of the Green Shipping Challenge,[89] encouraging governments, ports, and companies to prepare commitments to spur the transition to green shipping. The Challenge featured more than 40 major announcements on issues such as production of zero-emission fuels, investment in zero-emission technologies and vessels, and creation and expansion of green shipping corridors. Domestically, the Administration is investing $2.25 billion from the BIL to overhaul U.S. ports through the Maritime Administration's Port Infrastructure Development Program, which will build resilient infrastructure and reduce emissions.[90] The IRA also supports a $3 billion rebate and grant program at the Environmental Protection Agency (EPA) to provide funding for zero-emission port equipment and technology. Through a coordinated, innovative approach to decarbonizing the maritime shipping industry, the United States is investing in a more efficient, safer, cleaner, and just future.

OCAP Actions: Below is a summary of the Green Maritime Shipping OCAP Actions. For expanded details on these OCAP Actions, please see the Appendix, which lists responsible departments and agencies and projected timelines.

- **Advance U.S. commitment to achieve zero emissions from international shipping no later than 2050**, working with countries in the International Maritime Organization, and contribute to global efforts to accelerate decarbonization of the sector this decade to help achieve a 1.5°C warming-aligned pathway toward full decarbonization. Key Agencies: DOE, State/SPEC, DOT, MARAD, CMTS, USCG, EPA, NOAA
- **Accelerate maritime green shipping corridor development through research and development** by identifying and advancing opportunities for corridors along existing maritime trade routes, including along the Great Lakes/Saint Lawrence Seaway System, as well as with partners in other green shipping corridor projects, such as with the Republic of Korea and the United Kingdom; improving efficiency of maritime transportation system; investing in U.S. technology and manufacturing for maritime applications; and co-locating low- and zero emission fuel hubs with port facilities and terminals along green shipping corridors. Key Agencies: DOE, State/SPEC, DOT, EPA, MARAD, NOAA, USCG, CMTS

[87] The White House. "FACT SHEET: President Biden's Leaders Summit on Climate." (April 23, 2021). https://www.whitehouse.gov/briefing-room/statements-releases/2021/04/23/fact-sheet-president-bidens-leaders-summit-on-climate/.
[88] Department for Transport, UK Government. (2021). COP 26: Clydebank Declaration for green shipping corridors. https://www.gov.uk/government/publications/cop-26-clydebank-declaration-for-green-shipping-corridors. Last accessed March 2023.
[89] U.S. Department of State. Launch of the Green Shipping Challenge at COP27. https://www.state.gov/launch-of-the-green-shipping-challenge-at-cop27/. Last accessed March 2023.
[90] U.S. Department of Transportation Maritime Administration. Bipartisan Infrastructure Law: Maritime Administration. https://www.maritime.dot.gov/about-us/bipartisan-infrastructure-law-maritime-administration. Last accessed March 2023.

- **Green the Nation's ports by upgrading, modernizing, and decarbonizing port infrastructure and operations** by accelerating transportation electrification and enhancing port information infrastructure; prioritize resources to environmental justice communities and the co-benefits of reduced local air pollution. Key Agencies: DOE, EPA, MARAD, CMTS, USACE
- **Incentivize and enable the shipping industry to adopt zero-emission fuels and technologies** by establishing a dedicated funding program for U.S. vessel owner and operators to adopt greener technology; advancing research, development, and demonstration of new fuels and technologies for maritime decarbonization; accelerating adoption and availability of alternative fuels; and promoting diverse, STEM-focused maritime workforce development. Key Agencies: DOE, State/SPEC, DOT, EPA, CMTS, MARAD, USCG
- **Revolutionize ship construction to build zero-emission U.S.-flag commercial fleet** by promoting design, construction, conversion, and operation of vessels with net-zero GHG gas emissions; accelerate transition to a zero-emission U.S. Federal fleet (non-military); and explore methods to reduce or eliminate GHG emissions during vessel construction. Key Agencies: CBP, DOD, DOE, MARAD, NOAA, USCG.

Sequestration of CO_2 in Sub-seabed Geologic Formations

Objective: Advance the knowledge base and capacity for sequestration of captured CO_2 in sub-seabed geologic formations as one avenue to reduce net CO_2 emissions and contribute in a meaningful way to U.S. climate mitigation commitments. Scientific and socioeconomic information is needed to develop a regulatory framework based on Congressionally-mandated requirements for sub-seabed sequestration of CO_2 that will ensure safe, long-term carbon storage and protect human health, the marine environment, and potentially affected communities, particularly those that are historically overburdened. Regulators and managers will require improved knowledge about the efficacy, costs, tradeoffs, and human and environmental impacts of sub-seabed sequestration to make informed management decisions.

Background: Sub-seabed sequestration of CO_2 involves transferring captured CO_2 (often from point sources in coastal or marine industrial sites, or from direct air capture) and storing it long-term in marine sub-seabed geologic formations.[91] [92] According to the Intergovernmental Panel on Climate Change (IPCC), in addition to greenhouse gas emissions reductions, carbon dioxide removal and sequestration is critical to decarbonization, in particular for difficult-to-abate sectors such as steel. Extensive data from the Gulf of Mexico – a region critical to the U.S. energy transition – has allowed BOEM to estimate sub-seabed carbon storage capacity for the U.S. OCS in the region, which contains potential storage sites in both depleted oil and gas reservoirs, and saline aquifer reservoirs.[93] **In order to protect the health and safety of local communities and minimize risks to the marine environment while supporting long-term CO_2 storage, these Congressionally-mandated regulations must be robust, effective, science- and evidence-based, and must not disproportionately burden communities.**

Challenges: While there are notable long-term projects in Norway, and considerable prior research on sub-seabed geologic sequestration of CO_2, no sub-seabed CO_2 sequestration projects have been implemented in the United States.[94] Prior to any projects going forward, safeguards and appropriate detection and routine monitoring capacity need to be developed to protect against releases of the captured carbon during transportation, most likely as supercritical CO_2 in pipelines or vessels, and leakage subsequent to injection into geologic formations. Examples of areas ripe for additional R&D and analysis include: assessing methods for long-term monitoring of the CO_2 plume within the offshore sub-seabed reservoir as well as the surrounding environment, including the seafloor and overlying water column; optimizing lease spacing and multiple uses of the water column above the sequestration reservoir; developing emergency response and contingency plans prior to granting leases; and understanding the potential impacts of spilled or leaked CO_2 on the marine environment and how to mitigate these impacts. Clarifying and communicating the interplay between regulatory regimes across

[91] Hoegh-Guldberg, O., Caldeira K., Chopin. T. et al. (2019). The Ocean as a Solution to Climate Change: Five Opportunities for Action. World Resources Institute. https://oceanpanel.org/wp-content/uploads/2022/06/HLP_Report_Ocean_Solution_Climate_Change_final.pdf; Hoegh-Guldberg, O., Northrop, E. & Lubchenco, J. (2019). The ocean is key to achieving climate and societal goals. *Science* 365(6460): 1372-1374 https://www.science.org/doi/10.1126/science.aaz4390.

[92] The White House. (2021). Council on Environmental Quality Report to Congress on Carbon Capture, Utilization, and Sequestration. https://www.whitehouse.gov/wp-content/uploads/2021/06/CEQ-CCUS-Permitting-Report.pdf Last accessed March 2023.

[93] Bureau of Ocean Energy Management. Carbon Sequestration. https://www.boem.gov/about-boem/regulations-guidance/carbon-sequestration. Last accessed March 2023.

[94] Department of Energy National Petroleum Council. (2019, updated 2021). Meeting the Dual Challenge: A Roadmap to At-Scale Deployment of Carbon Capture, Use, and Storage. Chapter Seven – CO2 Geologic Storage. https://www.energy.gov/sites/default/files/2022-10/CCUS-Chap_7-030521.pdf. Last accessed March 2023.

marine spaces will be necessary to gain industry confidence, ensure smooth compliance, and protect human and environmental health.

Progress: The BIL amended the Outer Continental Shelf Lands Act (OCSLA) to authorize the Secretary of the Interior to grant a lease, easement, or right-of-way on the Outer Continental Shelf for activities that "*provide for, support, or are directly related to the injection of a carbon dioxide stream into sub-seabed geologic formations for the purpose of long-term carbon sequestration*."[95] As required in the BIL, BOEM and the Bureau of Safety and Environmental Enforcement (BSEE) are jointly developing regulations for geologic sequestration on the U.S. OCS.[96] The EPA regulates geologic carbon dioxide sequestration onshore and in the sub-seabed, in state ocean waters and beyond the OCS, under its existing authorities: the Safe Drinking Water Act (SDWA) and the Marine Protection, Research, and Sanctuaries Act (MPRSA). The London Convention and London Protocol have established an international regulatory framework and have developed international guidance for sequestration of carbon dioxide streams in sub-seabed geologic formations.[97] The United States is a party to the London Convention and has signed but not yet ratified the London Protocol.[98]

OCAP Actions: Below is a summary of the Sequestration of CO_2 in Sub-seabed Geologic Formations OCAP Actions. For expanded details on these OCAP Actions, please see the Appendix, which lists responsible departments and agencies and projected timelines.

- **Develop a marine geologic sequestration program for the U.S. Outer Continental Shelf** through promulgation of appropriate rules, as directed by Congress in the Bipartisan Infrastructure Law, and informed by robust public outreach. Key Agencies: DOI/BOEM/BSEE
- **Assess opportunities to harmonize regulatory frameworks for sub-seabed CO_2 sequestration in geologic formations across the marine space** by clarifying and communicating domestic regulatory regimes and domestic and international governance frameworks; ensuring smooth interagency and inter-governmental coordination; considering capacity needs for regulatory agencies to address permitting and regulation; and implementing a marine geologic sequestration program on the Outer Continental Shelf under OCSLA, and an onshore and marine geologic sequestration program for state ocean waters and beyond the Outer Continental Shelf through implementation of SDWA and MPRSA. Key Agencies: DOI/BOEM/BSEE, EPA, DOE, DOI, State/SPEC.
- **Advance research, monitoring and development on sub-seabed CO_2 sequestration** on pilot to full-scale demonstration projects on CO_2 transportation, injection and storage, site screening and environmental monitoring, assessment of human and environmental impacts, and decision-support tools for stakeholders and regulators. Key Agencies: DOE, DOI/BOEM/BSEE, EPA, NOAA

[95] Infrastructure Investment and Jobs Act, Pub. L. No. 117-58, § 40307(b), 135 Stat. 429, 1003 (2021).
[96] Bureau of Ocean Energy Management. Carbon Sequestration. https://www.boem.gov/about-boem/regulations-guidance/carbon-sequestration. Last accessed March 2023.
[97] International Maritime Organization. (2012). Specific guidelines for the assessment of carbon dioxide for disposal into sub-seabed geological formations. London Convention 34/15, annex 8. https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/2012%20SPECIFIC%20GUIDELINES%20FOR%20THE%20ASSESSMENT%20OF%20CARBON%20DIOXIDE.pdf. Last accessed March 2023.
[98] As a signatory, the United States has an obligation to refrain, in good faith, from acts that would defeat the object and purpose of the Protocol, though the United States does not yet consent to be bound by the terms of the Protocol itself.

Marine Carbon Dioxide Removal

Objective: By 2030, build sufficient knowledge about the efficacy and tradeoffs of different methods marine carbon dioxide removal (CDR) and use it to guide deployment decisions. This knowledge base is needed to determine if and how various proposed techniques are viable options for the United States to reduce net CO_2 emissions and contribute in a meaningful way to U.S. climate mitigation commitments. Develop a robust regulatory framework for research and possible later deployment to protect human health, the marine environment, and potentially affected communities, and ensure safe and effective long-term carbon dioxide removal.

Background: Marine carbon dioxide removal (CDR) refers to deliberate efforts to increase the amount of atmospheric CO_2 taken up by the ocean,[99] adding to the large natural ocean carbon sink. **The deployment of safe and effective land- or ocean-based CDR approaches is increasingly seen by many scientific assessments as necessary in the near future to meet climate goals.**[100] Marine CDR spans a wide range of approaches, each with different levels of scientific and technical maturity, knowledge gaps, environmental concerns, and barriers to deployment. A viable CDR technique would be one that can be shown to reliably to remove CO_2 from the atmosphere, sequester carbon dioxide for multiple decades or longer, have limited and understood environmental and social impacts, and consider DOE Carbon Negative Shot™ guidelines for CDR scalability and cost. Carbon removal by protection and restoration of coastal and open-water vegetated habitats is covered separately in the Blue Carbon section below. This section examines marine CDR approaches that increase ocean carbon storage in seawater, through incorporation into marine life or in marine sediments. These CDR approaches may include chemical methods (e.g., alkalinity enhancement and electrochemical direct ocean uptake) or biological methods (e.g., ocean ecosystem and marine life recovery, seaweed cultivation, and enhancement of marine biological carbon pump by iron/nutrient fertilization and artificial upwelling).[101] Co-location of renewable energy sources should be emphasized for CDR approaches that require energy.

Marine CDR approaches are in relatively early phases of development and more knowledge is required before decisions can be made about any future deployment as climate mitigation tools**. A substantial ramp up in marine CDR research and development investments, and enhanced interagency coordination is needed to evaluate efficacy and ensure safe and effective implementation and regulation of these techniques to mitigate climate change, while not adversely impacting human health, the marine environment, and other uses of the sea.** Safe and effective implementation will require the ability to continuously monitor impacts of mitigation actions, and knowledge of how the natural ocean carbon sinks change in parallel with purposeful CDR efforts. Successful adaptation will also require sustained observations across a wide range of spatial scales to inform long-term planning based on documented trends. It is crucial to have early, frequent, and meaningful engagement with stakeholders and local communities where marine CDR may be deployed to ensure that justice and

[99] National Academies of Sciences, Engineering, and Medicine. (2022). A Research Strategy for Ocean-based Carbon Dioxide Removal and Sequestration. The National Academies Press. https://nap.nationalacademies.org/catalog/26278/a-research-strategy-for-ocean-based-carbon-dioxide-removal-and-sequestration.

[100] National Academies of Sciences, Engineering, and Medicine. (2019). Negative Emissions Technologies and Reliable Sequestration: A Research Agenda. https://doi.org/10.17226/25259.

[101] National Academies of Sciences, Engineering, and Medicine. (2022). A Research Strategy for Ocean-based Carbon Dioxide Removal and Sequestration. The National Academies Press. https://nap.nationalacademies.org/catalog/26278/a-research-strategy-for-ocean-based-carbon-dioxide-removal-and-sequestration.

equity are addressed and prioritized during research and development. In particular, the impacts of marine CDR should not fall disproportionately on Tribal, Indigenous, low-income, or marginalized communities.

Carbon dioxide removal activities, including research, that involve the transportation and disposition of material into the ocean environment (e.g., ground-up rock for alkalinity enhancement or iron for fertilization) may require a Marine Protection, Research, and Sanctuaries Act (MPRSA) permit issued by EPA. The MPRSA regulates the transportation and disposition of any material into ocean waters, unless expressly excluded.[102] Other statutes that may pertain to marine CDR activities include the Clean Water Act and the Rivers and Harbors Act.

Challenges: Knowledge gaps include the efficacy, scalability, and the permanence or time-scale of carbon removal and sequestration; standardized carbon accounting and verification rules, thus, are essential, as is full life-cycle analysis of the GHG emissions of different methods. Marine CDR techniques have the potential to pose significant adverse impacts to marine ecosystems, human health, and the blue economy, and these potential impacts, along with possible co-benefits, need to be carefully evaluated.[103]

Progress: Research recommendations for marine CDR have been identified by the National Academies and in other reports,[104] [105] [106] NOAA has developed a draft CDR research strategy,[107] and community efforts are underway on research codes of conduct.[108] New Federal R&D initiatives are underway through the National Oceanographic Partnership Program (NOPP) led by NOAA, and DOE's Advanced Research Projects Agency-Energy (ARPA-E) on marine CDR techniques and their potential co-benefits (e.g., reducing ocean acidification; conservation), environmental impacts, and measuring, monitoring, reporting and verification (MMRV). Federal efforts are complemented by marine CDR R&D investments by philanthropy and industry. The Biden-Harris Administration has committed to the research and development of a broad suite of CDR approaches that will emphasize environmental justice, community engagement and consent-based siting, equity, and workforce development.[109] In October 2022, Parties to the London Convention and London Protocol, which is primarily implemented in the United States through the MPRSA and its supporting regulations, adopted a statement identifying the need to carefully evaluate marine geoengineering techniques (such as marine CDR), because while

[102] 33 U.S.C. § 1401 et seq.
[103] Loomis, R. Cooley, S.R., Collins, J.R. (2022). A Code of Conduct Is Imperative for Ocean Carbon Dioxide Removal Research. Frontiers in Marine Science 9. https://www.frontiersin.org/articles/10.3389/fmars.2022.872800/full.
[104] National Academies of Sciences, Engineering, and Medicine. (2022) "A Research Strategy for Ocean-based Carbon Dioxide Removal and Sequestration." https://nap.nationalacademies.org/catalog/26278/a-research-strategy-for-ocean-based-carbon-dioxide-removal-and-sequestration.
[105] National Academies of Sciences, Engineering, and Medicine. (2022). Cross-Cutting Themes for U.S. Contributions to the UN Ocean Decade. https://doi.org/10.17226/26363. https://doi.org/10.17226/26363.
[106] GESAMP (2019). High level review of a wide range of proposed marine geoengineering techniques. (Boyd, P.W. and Vivian, C.M.G., eds.). (IMO/FAO/UNESCO-IOC/UNIDO/WMO/IAEA/UN/UN Environment/ UNDP/ISA Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection). Rep. Stud. GESAMP No. 98. http://www.gesamp.org/publications/high-level-review-of-a-wide-range-of-proposed-marine-geoengineering-techniques.
[107] Cross, J.N., Gledhill, D.K., Sweeney, C. et al. (2022). NOAA Carbon Dioxide Removal Research: A White Paper documenting a Potential NOAA CDR Science Strategy as an element of NOAA's Climate Mitigation Portfolio. https://sciencecouncil.noaa.gov/Portals/0/Documents/Clean%20copy%20of%20Draft%20CDR%20Research%20Strategy.pdf?ver=2022-09-21-143831-560
[108] The Aspen Institute. (2021). Guidance for Ocean-Based Carbon Dioxide Removal Projects: A Pathway to Developing a Code of Conduct. https://www.aspeninstitute.org/wp-content/uploads/files/content/docs/pubs/120721_Ocean-Based-CO2-Removal_E.pdf.
[109] The White House. (2021). Council on Environmental Quality Report to Congress on Carbon Capture, Utilization, and Sequestration. https://www.whitehouse.gov/wp-content/uploads/2021/06/CEQ-CCUS-Permitting-Report.pdf Last accessed March 2023.

these techniques may have potential to mitigate climate change impacts, they may also adversely impact the marine environment.[110]

OCAP Actions: Below is a summary of the OCAP Actions related to Marine Carbon Dioxide Removal. For expanded details on these OCAP Actions, please see the Appendix, which also lists responsible departments and agencies and projected timelines.

- **Set policy and regulatory standards for marine CDR research and implementation** by clarifying domestic regulatory regimes and domestic and international governance frameworks; establishing guidelines for transparent MMRV; engaging in robust public outreach; and considering capacity needs for regulatory agencies to address permitting and regulation. Key Agencies: DOE, EPA, NOAA, State/SPEC, USACE, SOST
- **Implement a comprehensive Federal research and scaled testing program for promising marine CDR approaches, including marine energy sources,** considering recommendations from the 2022 NASEM ocean-based CDR report and similar science community reports (e.g., the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) Working Group 41 on marine geoengineering), while adhering to appropriate regulatory frameworks to ensure the protection of human health and the environment; focus research on efficacy of atmospheric CO_2 removal, permanence of carbon storage, scalability, energy and resource demands, costs, and environmental and social impacts. Key Agencies: DOE, EPA, NOAA, USACE
- **Launch a U.S. Marine CDR Initiative** to serve as a coordination vehicle for public-private funded research activities and to facilitate the creation of new marine CDR demonstration sites with the goal of delineating marine CDR benefits, risks, and challenges. Key Agencies: SOST, NOAA, NSF, EPA, DOE
- **Ensure robust, sustained, and adequate ocean observations (*in situ*, remote sensing) are in place** to enable assessments of ecosystem health before, during, and after marine CDR activities and for testing and refining ocean climate models that will inform further marine CDR efforts. Key Agencies: NASA, NOAA, NSF, DOE
- **Develop standards for carbon accounting for marine CDR approaches** by incorporating metrics on atmospheric CO_2 removal scale, carbon storage duration, and emissions of other GHGs; develop pilot programs to test approaches and expanded capabilities for MMRV. Key Agencies: DOE, DOI, EPA, NASA, NOAA, SOST
- **Evaluate the environmental and social impacts of marine CDR approaches** as an integral component of research and implementation projects; invest in environmental and social science research on effects on people and communities, capability to mitigate ocean acidification, and other possible co-benefits at local to regional scales. Key Agencies: DOE, EPA, NOAA, USACE, SOST
- **Incorporate environmental justice and equity in marine CDR research and implementation** through a U.S. community-developed code of conduct for responsible and ethical R&D; broad public engagement to minimize impacts and inequities on local populations; and global efforts to align with sustainable development and climate justice goals. Key Agencies: DOE, State/SPEC, EPA, NOAA, USACE

[110] International Maritime Organization. Marine geoengineering techniques - potential impacts. (October 10, 2022). https://www.imo.org/en/MediaCentre/PressBriefings/Pages/Marine-geoengineering.aspx. Last accessed March 2023.

OCAP Priority: Address Ocean Acidification

The increase in atmospheric CO_2 levels caused by human activities drives ocean acidification as well as climate change. Roughly a quarter of annual CO_2 emissions, or about 10 billion metric tons per year, is absorbed from the atmosphere by the ocean. This CO_2 undergoes a series of chemical reactions that makes seawater more acidic, reducing pH and causing other changes in seawater chemistry, including a reduction in carbonate ions. Many marine organisms are sensitive to these changes, particularly corals, shellfish, and other marine life that make skeletons and shells from calcium carbonate. Ocean acidification also amplifies other environmental stressors such as ocean warming, hypoxia (oxygen deficient zones), and harmful algal blooms. Many of the species that are at risk have high commercial, cultural, and biodiversity value, lending urgency to the need to reduce ocean acidification.

Global solutions for ocean acidification require rapidly stabilizing and reducing atmospheric CO_2 levels. Some nature-based ocean climate actions also can contribute to local-scale ocean acidification reduction by taking up excess CO_2 from seawater and enhancing ecosystem resilience. Efforts to reduce nutrients flowing into coastal waters can reduce both acidification and hypoxia, which are directly linked chemically, especially in bottom waters. Similarly, some marine CDR approaches may reduce the local severity of ocean acidification, either by lowering seawater CO_2 levels by removing inorganic carbon in the form of CO_2 gas, or by adding alkalinity to seawater, which buffers excess CO_2. Proposed climate interventions such as solar radiation management would not resolve ocean acidification, which will continue to worsen as along as human CO_2 emissions remain high. Monitoring of and research into impacts of ocean and coastal acidification is an ongoing high priority, especially because this additional information better enables communities and industries to adapt.

At the 2022 United Nations Ocean Conference in Lisbon, Portugal, the United States announced the intention to create a U.S. Ocean Acidification Action Plan (OA-AP) as part of joining the International Alliance to Combat Ocean Acidification. As described most recently at COP27 in November 2022, the OA-AP aims to 1) identify and promote U.S. actions that address the root causes of ocean acidification (carbon emissions reduction and nutrient pollution), 2) highlight U.S. leadership and priorities, 3) highlight the coordinated approach the United States has taken to study and address ocean and coastal acidification across Federal, Tribal, State, and local levels, 4) identify scientific gaps and opportunities for further action, including ocean acidification reduction through marine CDR and control of nutrient pollution, and 5) promote and lead greater international collaboration between members of the OA Alliance and other interested countries. The OA-AP will build upon the OCAP.

Further Action: Below is a summary of the actions that Departments and agencies can take to address ocean acidification. For expanded details on these actions, please see the Appendix, which lists responsible agencies and projected timelines.

- **Accelerate research and monitoring on ocean acidification.** Key Agencies: NASA, NOAA, DOI/USGS, EPA, SOST, NSF
- **Expand engagement with U.S. coastal communities vulnerable to ocean acidification, especially Tribal communities.** Key Agencies: NOAA, EPA
- **Create a U.S. Ocean Acidification Action Plan.** Key Agencies: NOAA, State/SPEC, EPA, NSF, NASA, SOST
- **Continue to raise awareness about ocean acidification as a significant problem for marine life, fisheries and aquaculture, and a sustainable ocean economy, and seek international**

partnerships to address the problem. Key Agencies/Offices: NOAA, EPA, State/SPEC, NSC, OSTP

- **Ensure that ocean acidification and its impacts are included in discussions of potential solar geoengineering and carbon dioxide removal approaches.** Key Agencies/Offices: NOAA, State/SPEC, NSC, OSTP, EPA

ACCELERATE NATURE–BASED SOLUTIONS

Nature-based solutions used in coastal areas often include restoration or conservation of coastal habitats like salt marsh, mangroves, and coral and oyster reefs. These habitats can help provide coastal flood protection by reducing wave action, slowing erosion and reducing impacts of coastal storms. They can also sequester and store carbon, improve water quality, and enhance local fish and bird populations. These benefits can support local economies and livelihoods, and improve the health and prosperity of people living in coastal communities. Several Federal programs support the deployment of nature-based solutions.[111] At COP27, the Biden-Harris Administration released the Nature-Based Solutions Roadmap, an outline of strategic recommendations to develop and implement nature-based solutions to climate change, nature loss, and inequity,[112] and highlighted $25 billion in infrastructure and climate funding allocated across Federal agencies that can advance nature-based solutions.[113] Advancing nature-based solutions also contributes to the Biden-Harris Administration's land and ocean conservation goals represented in the America the Beautiful Initiative.[114]

Blue Carbon

Objective: Advance the protection, conservation, restoration, and sustainable management of coastal and marine habitats that naturally capture and store carbon ("blue carbon") as a key element of U.S. land and ocean conservation and climate mitigation goals through nature-based solutions.[115] Include the protection, conservation, and restoration of blue carbon habitats, which also provide social, environmental, and biodiversity benefits, as a priority in coastal resource planning and management decisions. Quantify potential for blue carbon contributions to climate mitigation targets.

Background: Coastal habitats such as seagrasses, wetlands, mangroves, and salt marshes remove and store large amounts of blue carbon in plant biomass and in underlying deep, carbon-rich sediments. These **blue carbon ecosystems are able to sequester carbon at a comparatively much greater rate per unit area than terrestrial habitats,[116] making them some of the most efficient natural carbon**

[111] White House Coastal Resilience Interagency Working Group. (2022). Compendium of Federal Nature-Based Resources for Coastal Communities, States, Tribes, and Territories. https://www.noaa.gov/sites/default/files/2022-04/Nature-based-Solutions-Compendium.pdf.https://www.noaa.gov/sites/default/files/2022-04/Nature-based-Solutions-Compendium.pdf.

[112] White House Council on Environmental Quality, White House Office of Science and Technology Policy, White House Domestic Climate Policy Office. (2022). Opportunities for Accelerating Nature-Based Solutions: A Roadmap for Climate Progress, Thriving Nature, Equity, and Prosperity. Report to the National Climate Task Force. https://www.whitehouse.gov/wp-content/uploads/2022/11/Nature-Based-Solutions-Roadmap.pdf.

[113] The White House. FACT SHEET: Biden-Harris Administration Announces Roadmap for Nature-Based Solutions to Fight Climate Change, Strengthen Communities, and Support Local Economies. (November 8, 2022), https://www.whitehouse.gov/briefing-room/statements-releases/2022/11/08/fact-sheet-biden-%E2%81%A0harris-administration-announces-roadmap-for-nature-based-solutions-to-fight-climate-change-strengthen-communities-and-support-local-economies/.https://www.whitehouse.gov/briefing-room/statements-releases/2022/11/08/fact-sheet-biden-%E2%81%A0harris-administration-announces-roadmap-for-nature-based-solutions-to-fight-climate-change-strengthen-communities-and-support-local-economies/.

[114] U.S. Department of the Interior. America the Beautiful. https://www.doi.gov/priorities/america-the-beautiful. Last accessed March 2023. https://www.doi.gov/priorities/america-the-beautiful.

[115] White House Council on Environmental Quality, White House Office of Science and Technology Policy, White House Domestic Climate Policy Office. (2022). Opportunities for Accelerating Nature-Based Solutions: A Roadmap for Climate Progress, Thriving Nature, Equity, and Prosperity. Report to the National Climate Task Force. https://www.whitehouse.gov/wp-content/uploads/2022/11/Nature-Based-Solutions-Roadmap.pdf.

[116] National Academies of Sciences, Engineering, and Medicine. 2019. *Negative Emissions Technologies and Reliable Sequestration: A Research Agenda*. Washington, DC: The National Academies Press, https://doi.org/10.17226/25259; Mcleod, Elizabeth, et al. "A Blueprint for Blue

sinks in the world.[117] There is a robust body of research into these carbon-storing abilities—including guidelines provided by the IPCC[118] for inclusion in National Greenhouse Gas Inventories (NGGI)—in addition to research on advanced coastal land cover mapping capabilities,[119] which assists in accounting for blue carbon in climate mitigation plans. Other coastal marine ecosystems, such as kelp forests and other macroalgal habitats, are increasingly being studied and recognized for their carbon storing abilities, which expands the potential of blue carbon as an important climate solution.[120] Some scientists extend the blue carbon concept to open ocean micro- and macro-algae, macro-organisms, and marine sediments on the continental shelf and in the deep sea.[121]

Healthy coastal blue carbon ecosystems contribute ecosystem services and provide protection against storms and coastal change. For instance, these habitats serve as feeding and nursery grounds for commercially-important fish and shellfish, provide valuable wildlife habitat, protect coastal infrastructure from flooding, storm surge, and sea-level rise, and help to filter out excess nutrients and other harmful substances. However, in many regions these ecosystems are declining due to development and other human activities – for example, an estimated 95,000 acres of saltwater wetland was lost between 2004 and 2009, primarily in the Gulf of Mexico.[122]

Conserving existing blue carbon habitats (for example within marine and coastal reserves) and enhancing, augmenting, restoring, and sustainably managing coastal blue carbon systems can reduce additional greenhouse gas emissions and help maintain coastal ecosystems that sequester and store blue carbon, while also providing other valuable co-benefits.[123]

Challenges: Coastal blue carbon habitats are spatially constrained, covering less than 1 percent of the Earth's surface.[124] While healthy blue carbon ecosystems are efficient natural carbon sinks, if degraded or lost to coastal development, climate change, or other human activities, these systems are likely to release stored carbon to the atmosphere as CO_2 or methane, along with other harmful GHGs.[125] The amount of additional carbon removed from the atmosphere by coastal restoration remains uncertain, so the cost-effectiveness of blue carbon nature-based solutions as a climate mitigation action is not

Carbon: Toward an Improved Understanding of the Role of Vegetated Coastal Habitats in Sequestering Co 2." *Frontiers in Ecology and the Environment*, vol. 9, no. 10, 2011, pp. 552–560., https://doi.org/10.1890/110004.

[117] National Academies of Sciences, Engineering, and Medicine. 2019. *Negative Emissions Technologies and Reliable Sequestration: A Research Agenda*. Washington, DC: The National Academies Press, https://doi.org/10.17226/25259/.

[118] Intergovernmental Panel on Climate Change. (2014). 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands. Hiraishi, T., Krug, T., Tanabe, K., Srivastava, N., Baasansuren, J., Fukuda, M. and Troxler, T.G. (eds). https://www.ipcc-nggip.iges.or.jp/public/wetlands/index.html.

[119] USGS Water Resources. NASA-USGS National Blue Carbon Monitoring System. (March 2, 2019). https://www.usgs.gov/mission-areas/water-resources/science/nasa-usgs-national-blue-carbon-monitoring-system. Last accessed March 2023.

[120] Krause-Jensen, D., Duarte C.M. (2016). Substantial role of macroalgae in marine carbon sequestration. Nature Geoscience (9)10: 737–742. https://doi.org/10.1038/ngeo2790.https://doi.org/10.1038/ngeo2790.

[121] Christianson, A. Cabre, A. Bernal, B. et al. (2022). The Promise of Blue Carbon Climate Solutions: Where the Science Supports Ocean-Climate Policy. Frontiers in Marine Science 29(9):851448. https://doi.org/10.3389/fmars.2022.851448.

[122] Dahl, T.E. and Stedman, S.M. (2013). Status and trends of wetlands in the coastal watersheds of the Conterminous United States 2004 to 2009. U.S. Department of the Interior, Fish and Wildlife Service and National Oceanic and Atmospheric Administration, National Marine Fisheries Service. https://www.fws.gov/media/status-and-trends-wetlands-coastal-watersheds-conterminous-united-states-2004-2009.

[123] National Academies of Sciences, Engineering, and Medicine. (2019). Negative Emissions Technologies and Reliable Sequestration: A Research Agenda. https://doi.org/10.17226/25259.

[124] Brodeur, J., Cannizzo, Z., Cross, J. (2022). NOAA Blue Carbon White Paper. National Oceanic and Atmospheric Administration. https://doi.org/10.25923/v5fx-r089.

[125] Pendleton, L., Donato D.C, Murray B.C. et al. (2012). Estimating Global "Blue Carbon" Emissions from Conversion and Degradation of Vegetated Coastal Ecosystems. PLOS ONE 7(9): e43542. https://doi.org/10.1371/journal.pone.0043542.

well defined.[126] Although some evidence suggests carbon sequestration and other benefits can be restored, additional research is warranted.[127] Coastal wetlands and near-shore ecosystems vary considerably over short geographic distances, and many blue carbon habitats are especially sensitive to natural disturbances and human land-use pressures that release carbon. Even with the current advanced state of the science in coastal wetland blue carbon systems, issues with the reliability of blue carbon accounting persist, highlighting the need to increase and expand research into all aspects of this important mitigation tool to inform and guide coastal management and policy decisions.[128] Because coastal habitats are largely controlled and managed by states and local governments, policy decisions about prioritizing blue carbon habitats are decentralized.

Current scientific understanding is also insufficient to fully characterize the potential for other ecosystems, such as kelp forests and offshore sediments, to act as carbon sinks and to sequester and store carbon away from the atmosphere for long time scales. Fast-growing kelp and macroalgae temporarily store large amounts of carbon in biomass, but more research and carbon accounting efforts are needed on the long-term fate of that carbon and the sequestration benefit from conservation and restoration of kelp forests.[129] Marine sediments accumulate organic carbon at a generally lower rate than coastal blue carbon systems, but over larger areas. Because many of these sediments have been accumulating on the seafloor for centuries to millennia, they represent significant stores of carbon.[130] Natural and human disturbances of continental shelf and slope sediments can release CO_2 and possibly methane into the water column from marine sediments rich in organic carbon, though it is yet unclear how much is released from disturbed sediments, how long it would remain in the water column, and how much of this released gas would reach the atmosphere.[131] Therefore, a better understanding of the relationship between marine sediment disturbance, resettlement, CO_2 release and atmosphere exchange, and the carbon cycle could enhance climate information. A large advancement in our ability to manage blue carbon and leverage its mitigation potential may come from increasing our understanding of these and other oceanic blue carbon processes.

Progress: Advances in coastal land cover mapping capabilities and standard carbon storage and sequestration accounting methodologies for some habitats provide an initial basis for including blue

[126] Williamson, P. & Gattuso, J. (2022). Carbon Removal Using Coastal Blue Carbon Ecosystems Is Uncertain and Unreliable, With Questionable Climatic Cost-Effectiveness. Frontiers in Climate 4: 4:853666. https://doi.org/10.3389/fclim.2022.853666.
[127] Orth, R.J., Lefcheck, J.S., McGlathery K.S. et al. (2020). Restoration of seagrass habitat leads to rapid recovery of coastal ecosystem services. ScienceAdvances 6(41): eabc6434. https://www.science.org/doi/10.1126/sciadv.abc6434.
https://www.science.org/doi/10.1126/sciadv.abc6434.
[128] Atwood, T.B., Witt, A., Mayorga, J. et al. (2020.) Global Patterns in Marine Sediment Carbon Stocks. Frontiers in Marine Science 7. https://www.frontiersin.org/articles/10.3389/fmars.2020.00165/full.
[129] National Academies of Sciences, Engineering, and Medicine. (2019). Negative Emissions Technologies and Reliable Sequestration: A Research Agenda. https://doi.org/10.17226/25259. Also, climate change and an increase in nutrients in coastal and marine waters has yielded an overabundance of a macroalgae called sargassum in recent years, with significant challenges to the Caribbean nations where this seaweed comes ashore, especially for tourism and fisheries. Communities are highly motivated to develop novel uses for the sargassum, and research is ongoing. See for example "Challenges of Turning the Sargassum Crisis into Gold: Current Constraints and Implications for the Caribbean" *available at* https://www.mdpi.com/2673-9410/1/1/3/htm.
[130] Atwood, T.B., Witt, A., Mayorga, J. et al. (2020.) Global Patterns in Marine Sediment Carbon Stocks. Frontiers in Marine Science 7. https://www.frontiersin.org/articles/10.3389/fmars.2020.00165/full.
[131] Sala, E., Mayorga, J., Bradley, D. et al. Protecting the global ocean for biodiversity, food and climate. Nature 592, 397–402 (2021). https://doi.org/10.1038/s41586-021-03371-z and Hilborn, R., Kaiser, M.J. (2022). A path forward for analysing the impacts of marine protected areas. Nature 607, E1–E2 https://doi.org/10.1038/s41586-022-04775-1 and Sala, E., Mayorga, J., Bradley, D. *et al.* (20220. Reply to: A path forward for analysing the impacts of marine protected areas. *Nature* **607**, E3–E4 (2022). https://doi.org/10.1038/s41586-022-04776-0.

carbon contributions into NGGI[132] and climate mitigation planning.[133] The Interagency Coastal Wetlands Working Group (ICWWG) is implementing recommendations for reducing wetland loss in U.S. coastal watersheds scales, including efforts on habitat protection, restoration, landscape-scale monitoring data, and outreach and stakeholder engagement.[134] Federal agencies, like the Department of Defense, are already partnering with communities on initiatives to protect, conserve, and restore coastal blue carbon habitats.[135] In April 2022, the Administration announced the inaugural U.S. National Nature Assessment to create a holistic understanding of America's natural resources and the abundance of benefits and services they provide.[136] The first assessment will be delivered in 2026 and periodically thereafter. It will serve as a crucial baseline and will inform decision-making associated with ecosystem conservation and restoration to recover biodiversity loss, support economic recovery, build resilient infrastructure, and increase access to natural resources for historically excluded and marginalized communities.

OCAP Actions: Below is a summary of the Blue Carbon OCAP Actions. For expanded details on these OCAP Actions, please see the Appendix, which lists responsible departments and agencies and projected timelines.

- **Retain coastal blue carbon and carbon sequestration and storage as a priority in the America the Beautiful initiative to conserve at least 30 percent of U.S. lands and waters by 2030** by protecting, conserving, restoring, and sustainably managing coastal blue carbon ecosystems with the greatest potential to provide multiple climate and community benefits. Key agencies: CEQ, DOI/FWS, DOI/USGS, NOAA, USDA
- **Support research and development initiatives in known blue carbon habitats**; expand blue carbon knowledge, monitoring, quantification, mapping, and data access to support researchers, community of practice groups and policy makers; enhance research and observations on quantifying and predicting coastal wetland carbon fluxes across different habitats, geographic regions, levels of ecosystem protection and restoration, and under varying conditions, including effects of sea level rise and human drivers such as impacts of land management actions. Key Agencies: DOI/FWS, NASA, DOI/NPS, NOAA, DOI/USGS, SOST
- **Conduct research, exploration, and mapping to determine blue carbon potential of coastal and marine ecosystems** such as kelp and *Sargassum*, vertically migrating fishes and zooplankton, marine mammals, and marine sediments; and assess any long-term impacts on carbon storage from marine sediment disturbance. Key Agencies: DOE, NOAA, DOI, SOST
- **Develop standards for blue carbon monitoring and management for different coastal and ocean habitats** by improving carbon accounting tools, protocols, and valuation metrics; and

[132] NOAA. NOAA Blue Carbon Inventory Project Briefing Sheet. https://cpo.noaa.gov/Portals/0/Docs/IRAP/NOAA_BCIproject_BriefingSheet_4.21.21v2.pdf?ver=2021-04-29-162757-010. Last accessed March 2023.
[133] USGS Water Resources. NASA-USGS National Blue Carbon Monitoring System. (March 2, 2019). https://www.usgs.gov/mission-areas/water-resources/science/nasa-usgs-national-blue-carbon-monitoring-system. Last accessed March 2023.
[134] Interagency Coastal Wetlands Workgroup. 2022. Recommendations for Reducing Wetland Loss in Coastal Watersheds of the United States. https://www.epa.gov/system/files/documents/2022-06/ICWWG%20Recs_Final_508.pdf.
[135] Stevens, A. & Jones, S. (2020). Promoting Coastal Resilience Through Partnerships and Planning: Communities, Sea Grant Programs, SERPPAS, and Military Installations. Sea Grant Law & Policy 10(2). https://nri.tamu.edu/media/3076/promoting-coastal-resilience-through-partnerships-and-planning_v2.pdf.
[136] The White House. Accounting for Nature on Earth Day 2022. (April 24, 2022). https://www.whitehouse.gov/ostp/news-updates/2022/04/24/accounting-for-nature-on-earth-day-2022/. Last accessed March 2023.

measuring health, resilience, and recovery of blue carbon ecosystems. Key Agencies: DOI/FWS, NOAA, DOI/NPS, NASA, SOST

- **Prioritize conservation, protection, and enhancement of existing coastal blue carbon wetland habitats, and restoration of degraded or potential blue carbon habitats,** by researching the effectiveness of nature-based solutions and other management; identifying important wetland ecosystems for conservation; working with local, State, Tribal, and Territorial governments; and providing technical assistance for wetland conservation. Key Agencies: EPA, DOI/FWS, NOAA, DOI/USGS, USACE, OPC
- **Conduct regional to national research and monitoring of post-restoration coastal blue carbon habitats** to address the current lack of high-quality monitoring in blue carbon studies before and after restoration interventions, with the goal of including two reserves in each U.S. region (including in the Great Lakes) by 2026. Key Agencies: NOAA, DOI/FWS, SOST

Climate-Adaptive Marine Protected Areas

Objective: Create, strengthen, connect, and expand effective climate-adaptive Marine Protected Areas (MPAs) and other conserved areas. Well-planned, -resourced and -managed MPAs and other conserved areas provide a foundation for both local and national ecosystem conservation needs and promote healthy ocean ecosystems. If they reduce the relevant environmental stressors, MPAs and other conserved areas can be effective tools to help recover degraded or overexploited areas and populations and are an important approach for reducing further climate change impacts on marine environments. The ecosystem resilience imparted by effective protection, adaptive management, and connected MPA networks results in climate adaptation benefits to ecosystem and habitat health. Science, research, and knowledge can help ensure that MPAs are effective and climate-adaptive.

Background: Marine protected areas and other conserved areas can be effective mechanisms to conserve biodiversity, protect habitats that store carbon (see Blue Carbon section), support healthy ocean ecosystems and populations of living marine resources, and contribute to climate-ready fisheries. MPAs and other conserved areas protect key habitats for fish and other living marine resources, protect culturally significant sites, and provide opportunities for tourism, recreation, education, and research. MPAs are generally created and located to support healthy ecosystems and address specific threats.[137]

Level of protection matters – the science is clear that not all MPAs and other conserved areas have equal social or environmental outcomes.[138] Higher levels of protection in these areas correlate with higher ecological and social benefit.[139] Recent evidence shows that fisheries in waters adjacent to a large MPA that restricts extractive uses can be replenished by what researchers refer to as the "spillover effect."[140] Other conserved areas in coastal and ocean regions—for example, limited access areas or areas where certain fishing activities are restricted—can also provide some level of protection. Areas created for non-conservation purposes that similarly restrict access, such as military bases, navigational hazards, or offshore energy complexes may also have value for conserving marine resources.

Locally-tailored social and economic considerations are important factors in the design of equitable and effective MPAs.[141] [142] U.S. MPAs and other conserved areas are administered by various governmental entities and multi-level partnerships and include National Marine Sanctuaries, National Monuments, National Parks, National Wildlife Refuges and National Estuarine Research Reserves, National Estuary Program areas, as well as Tribal, State, Territorial, and local MPAs (see interactive map[143]). Establishing, implementing, monitoring, and enforcing MPAs and other conserved areas is an effective way to achieve long-term conservation of nature with associated ecosystem services and

[137] Kriegl, M. Elías Ilosvay X.E., von Dorrien, C. et al. (2021). Marine Protected Areas: At the Crossroads of Nature Conservation and Fisheries Management, Frontiers in Marine Science 8. https://www.frontiersin.org/articles/10.3389/fmars.2021.676264/full.
[138] Grorud-Colvert, K., Sullivan-Stack, J., Roberts C. et al. (2021). The MPA Guide: A framework to achieve global goals for the ocean. Science 373(6560). https://www.science.org/doi/10.1126/science.abf0861.
[139] Ibid.
[140] Medoff S., Lynham J., & Raynor J. (2022). Spillover benefits from the world's largest fully protected MPA. Science 378(6617):313-316. https://www.science.org/doi/10.1126/science.abn0098 https://www.science.org/doi/10.1126/science.abn0098.
[141] Grorud-Colvert, K., Sullivan-Stack, J., Roberts C. et al. (2021). The MPA Guide: A framework to achieve global goals for the ocean. Science 373(6560). https://www.science.org/doi/10.1126/science.abf0861.
[142] Andradi-Brown D.A., Veverka L., Amkieltiela et al. (2023). Diversity in marine protected area regulations: Protection approaches for locally appropriate marine management. Frontiers in Marine Science 10. https://www.frontiersin.org/articles/10.3389/fmars.2023.1099579.
[143] NOAA. MPA Inventory Interactive Map. https://marineprotectedareas.noaa.gov/dataanalysis/mpainventory/mpaviewer/. Last accessed March 2023. https://marineprotectedareas.noaa.gov/dataanalysis/mpainventory/mpaviewer/. Last accessed March 2023.

cultural values.[144] While NOAA, the Department of the Interior, and the Department of Defense have decades of experience in marine conservation, most of the existing MPAs and other conserved areas were designed without a specific focus on adapting to ocean climate change.

Climate-adaptive MPAs and other conserved areas management strategies may partially offset some of the climate and ocean acidification impacts that threaten marine ecosystems. Ecosystem health, species and genetic diversity, and resilience to climate change often determine the effectiveness of ocean- and coastal-based climate solutions.[145] It is essential, therefore, to conserve at least 30% and effectively manage 100% of U.S. ocean areas. While most MPAs and other conserved areas provide benefits to a particular area, it is important to target MPA size and location in order to achieve the desired management goal. Another approach is to consider designing networks of MPAs that protect core habitats for species at various life stages or provide areas for breeding, resting, feeding, and migrating to promote biodiversity, population persistence and resilience, and an increased capacity to adapt to environmental change. Equally important are networks that can function as stepping stones for species and communities to shift ranges as the climate changes. Importantly, water, nutrients, food sources, and marine life move across jurisdictional boundaries, and with many species' ranges rapidly shifting due to climate change, ecological connectivity is an important factor in developing climate-adaptive MPAs and other conserved areas.[146] [147]

Challenges: Challenges remain about how MPAs and other conserved areas can be designed to adapt to the changing climate of the future, while continuing to offer appropriate havens and ecosystem services where needed. New areas or revised boundaries for existing MPAs and other conserved areas need to be considered that both fit into existing networks and support management goals under new or evolving climate conditions. While the benefits of MPAs are well-documented, many MPAs and other conserved areas currently lack the robust monitoring data and research to demonstrate and quantify how the area and its management serves as a buffer against climate change impacts or builds resilience. Scientists are working to further quantify and assess the critical roles that MPAs and other conserved areas play in climate adaptation and resilience.

Despite the importance of connectivity, most MPAs and other conserved areas have been traditionally designated with little consideration of ecological linkages. Notable exceptions are the Channel Islands National Marine Sanctuary and the network of MPAs in California state waters that were explicitly designed with connectivity in mind. Both examples offer helpful guidance for how to overcome barriers to the inclusion of connectivity considerations into MPA design and management, such as national and state boundaries, legal authorities and policies, and conflicting stakeholder views requiring significant coordination. These challenges also exist when international cooperation is required for transboundary or high seas efforts, but are not insurmountable. Climate-adaptive strategies could delineate boundaries using dynamic conditions or as intended stepping stones for shifting ranges.

[144] Day J., Dudley N., Hockings M. et al. (2012). Guidelines for applying the IUCN Protected Area Management Categories to Marine Protected Areas. IUCN. https://www.iucn.org/sites/default/files/import/downloads/iucn_categoriesmpa_eng.pdf https://www.iucn.org/sites/default/files/import/downloads/iucn_categoriesmpa_eng.pdf.

[145] Seddon N., Chausson A., Berry P. et al. (2020). Understanding the value and limits of nature-based solutions to climate change and other global challenges. Philosophical Transactions of the Royal Society B 375(1794):20190120. https://royalsocietypublishing.org/doi/full/10.1098/rstb.2019.0120.

[146] Abram, Adler, Bindoff, Cheng, et al. (2019) IPCC Ocean/Cryosphere report https://www.ipcc.ch/srocc/.

[147] Begum, Lempert, Ali, Berjaminsen, Bernauer, et al. (2022) (AR6 WGII report https://report.ipcc.ch/ar6wg2/.

Progress: The United States has established nearly 1,000 MPAs, as well as other conserved areas, providing varying levels of protection from external stressors such as fishing, mining, oil and gas exploration and extraction, and habitat loss, to approximately 26% of our Nation's waters.[148] Most of these MPAs are geographically small and levels of protection vary by region.[149] For example, the Marine National Monuments in the Pacific prohibit almost all extractive activities, while MPAs in other regions allow for some resource extraction, such as through commercial fishing. If well-designed and implemented, these MPAs and other conserved areas can provide an important foundation and spatial blueprint for effective climate actions. Many of these areas are living laboratories for evaluating climate adaptation and mitigation effectiveness, allowing for control of non-climate stressors and impacts, as well as level of protection within the MPA or other conserved area. This setting provides long-term protection and management, supports monitoring and research, and is conducive to place-based partnerships that conserve and restore ocean resources, while also supporting new economic opportunities and environmental equity.

To include Tribal and Native Hawaiian voices, the Secretaries of Agriculture and the Interior issued a Joint Secretarial Order,[150] which the Secretary of Commerce later joined, instructing agencies under their direction (e.g., the U.S. Fish and Wildlife Service and NOAA) to pursue collaboration and co-stewardship of Federal lands, waters, and wildlife. An example of this approach to co-stewardship is the Mai Ka Po Mai guidance document for management of the Papahānaumokuākea Marine National Monument.[151] The National Marine Protected Areas Center (MPA Center), a partnership between NOAA and the U.S. Department of the Interior, is also a resource for Federal, Tribal, State, and Territorial programs responsible for the health of the Nation's marine resources.[152] The MPA Center is actively engaged around the world, sharing experience, tools, and lessons learned in assessing climate risks and adapting to a changing planet. Complementing this action, the Council on Environmental Quality and the Office of Science and Technology Policy issued guidance to agencies instructing them to consider and include Indigenous Knowledge in Federal decision-making.[153]

OCAP Actions: Below is a summary of the Climate-Adaptive Marine Protected Area OCAP Actions. For expanded details on these OCAP Actions, please see the Technical Appendix, which lists responsible departments and agencies and projected timelines.

- **Create, connect, strengthen, and expand Marine Protected Areas (MPAs) and MPA networks, while enhancing the connectivity of MPAs with one another, as well as onshore**

[148] National Marine Protected Areas, Marine Protected Area Coverage for the United States (2021) https://nmsmarineprotectedareas.blob.core.windows.net/marineprotectedareas-prod/media/docs/202104-us-mpa-coverage.pdf
[149] Sullivan-Stack, J., Aburto-Oropeza O., Brooks C.M. et al. (2022). A Scientific Synthesis of Marine Protected Areas in the United States: Status and Recommendations. Frontiers in Marine Science 9. https://www.frontiersin.org/articles/10.3389/fmars.2022.849927/full.
[150] DOI, Joint Secretarial Order on Fulfilling the Trust Responsibility to Indian Tribes in the Stewardship of Federal Lands and Waters (November 15 2021) https://www.doi.gov/sites/doi.gov/files/elips/documents/so-3403-joint-secretarial-order-on-fulfilling-the-trust-responsibility-to-indian-tribes-in-the-stewardship-of-federal-lands-and-waters.pdf.
[151] Office of Hawaiian Affairs, National Oceanic and Atmospheric Administration, U.S. Fish and Wildlife Service, and State of Hawai'i. (2021). Mai Ka Pō Mai: A Native Hawaiian Guidance Document for Papahānaumokuākea Marine National Monument. https://www.oha.org/wp-content/uploads/MaiKaPoMai_FINAL-web.pdf.
[152] NOAA National Marine Protected Areas Center. Marine Protected Areas. https://marineprotectedareas.noaa.gov/. Last Accessed March 2023
[153] Arati Prabhakar, Assistant to the President and Director, Office of Science and Technology Policy, & Brenda Mallory, Chair, Council on Environmental Quality. (2020). Memorandum for Heads of Federal Departments and Agencies, Guidance for Federal Departments and Agencies on Indigenous Knowledge. https://www.whitehouse.gov/wp-content/uploads/2022/12/OSTP-CEQ-IK-Guidance.pdf.

and inland conservation, and use adaptive management to address current conditions and future climate effects; create ecologically-connected MPA networks that promote climate resilience and account for species and habitat range shifts; and harness management tools to support mutual climate, conservation, and ocean co-use goals. Key Agencies: DOI, State/SPEC, DOI/FWS, DOI/NPS, NOAA, OPC

- **Promote public engagement, Tribal Consultation, and use of Indigenous Knowledge to advance climate-resilient MPAs** by developing with communities and ocean users a shared vision for ocean conservation and the benefits of MPAs; and identify roles, responsibilities, and opportunities for MPA management and research. Key Agencies: DOI/FWS, DOI/NPS, NOAA
- **Expand research and development of monitoring and predictive capabilities and climate-responsive adaptive management** to better understand the likely impacts of climate change on the resources residing within MPAs that would require climate-responsive management; the relationships between size and level of protection of an MPA and its climate resilience; the ability of MPAs of different types and sizes to create spillover and enhance resilience of fisheries in adjacent waters; ways to build ecosystem and wildlife resilience; how to improve options for dynamic MPA networks; and how to promote the use of climate and ocean data, information, and services by local communities. Key Agencies: DOI/FWS, DOI/NPS, NOAA
- **Prioritize work with Indigenous, urban, nature-deprived, and underserved communities to meet local and national needs through existing and new MPAs and MPA networks** by strengthening existing and establishing new community partnerships focused on nature-based solutions to local community concerns. Key Agencies: DOI/FWS, DOI/NPS, EPA, NOAA
- **Maximize the benefits of ocean co-use, by planning and siting non-extractive and non-destructive activities in or near MPAs where appropriate** by coordinating interagency discussion and planning through the OPC Ocean Resource Management sub-committee. Key Agencies: DOI/BOEM, NOAA, ORM
- **Strengthen co-stewardship of lands and waters with Tribal Nations and Indigenous Peoples** by building on experience and relationships with Tribal Nations and Indigenous groups and continuing to co-develop research programs and work towards co-stewardship of protected areas. Key agencies: DOI, NOAA.

Box: Ocean Co-benefits of Land-based Climate Actions

Ocean climate actions are part of a whole-of-government response to the climate crisis. Progress on climate actions occurring on land may result in substantial co-benefits for the ocean environment and the sustainable ocean economy. Pollution that affects ocean ecosystems can originate on shore, from industrial, agricultural, and commercial practices. Well-known examples include ocean plastic pollution, excess nitrogen and phosphorus runoff from fertilizers and concentrated livestock operations, and heavy metal (mercury, lead) deposition from fossil fuel combustion and industrial activities. Reducing these sources of stress on aquatic ecosystems can be a key pillar of ocean climate adaptation.[154] Currently, the production of plastics and fertilizers are fossil fuel-intensive and depend heavily on petroleum and natural gas for energy and feedstocks. Shifts in manufacturing processes, enhanced renewable energy use during production, increased recycling and efficiency, altered agricultural practices, Federal procurement preferences for low-carbon construction materials, and modernized wastewater and stormwater systems can provide climate mitigation benefits through direct reductions in GHG emissions, as well as reduce ocean pollution and subsequent environmental damage.

End Box

[154] Examples of Federal programs to reduce land-based pollution with significant benefits for the ocean include EPA's Trash-Free Waters and USDA's Natural Resource Conservation Service's voluntary conservation initiatives.

ENHANCE COMMUNITY RESILIENCE TO OCEAN CHANGE

The third set of ocean climate actions involves bolstering community resilience to ocean change. Through the BIL and IRA, the Biden-Harris Administration has committed historic investments, including $45 million towards Tribal communities to address the disproportionate impacts of climate change[155] and over $4 billion for coastal resilience and climate-ready fisheries.[156] [157] **Ocean climate adaptation actions protect and enhance the resilience of fisheries, aquaculture, coastal communities, and the sustainable ocean economy to a changing world.**

Climate-Ready Fisheries, Protected Resources, Aquaculture, and Fishing Communities

Objective: Advance and implement climate-informed management of fisheries and aquaculture and increase the resilience of fishing and other coastal communities.

Background: Climate change is significantly impacting the nation's valuable marine ecosystems, fisheries (commercial, recreation, and subsistence), protected resources, and aquaculture.[158] Rapidly warming seas and changing ocean chemistry are driving shifts in the distribution and abundance of marine life, which is affecting fisheries management, fisheries, aquaculture opportunities, and fishing communities in the U.S. The Federal fishery management regime authorizes fishing in certain locations and times and for certain stocks of fish using particular equipment. Thus, subsistence, commercial, charter for-hire, and recreational fishermen cannot easily and quickly adapt their activities to account for the biological and ecological changes that are already occurring. Information, tools, and flexible, anticipatory, precautionary, and climate-informed species management systems can build resilience and promote adaptation in fisheries, aquaculture, and fishing communities.[159] This is what we call "climate-ready fisheries."

Fisheries and aquaculture are an important source of food, jobs, economic activity, tourism, recreation and cultural heritage. In 2019, U.S. marine fishing and seafood industries generated over $255 billion in sales, contributed $117 billion to gross domestic product, and supported 1.8 million jobs.[160] Fishing and aquaculture are part of the history, economic foundation, and cultural heritage of many U.S. coastal communities, including historically disadvantaged and underserved populations, as well as Tribal Nations and Indigenous Peoples. Sustainably-managed fisheries can also help mitigate climate change, producing lower CO_2 emissions per unit output compared to almost all land-based animal

[155] DOI. President Biden's Bipartisan Infrastructure Law Support $45 Million Investment to Build Climate Resilience in Tribal Communities. (November 2, 2022). https://www.doi.gov/pressreleases/president-bidens-bipartisan-infrastructure-law-supports-45-million-investment-build.
[156] NOAA. Biden Administration announces historic coastal and climate resilience funding. (June 29, 2022). https://www.noaa.gov/news-release/biden-administration-announces-historic-coastal-and-climate-resilience-funding.
[157] NOAA. Statement from NOAA Administrator on signing of historic Inflation Reduction Act. (August 16, 2022). https://www.noaa.gov/news-release/statement-from-noaa-administrator-on-signing-of-historic-inflation-reduction-act.
[158] Fourth National Climate Assessment (2018). Chapter 9: Oceans and Marine Resources. https://nca2018.globalchange.gov/chapter/9/.
[159] Link, J.S., Griffis, R., Busch S. (eds). (2015). NOAA Fisheries Climate Science Strategy. NOAA. https://spo.nmfs.noaa.gov/sites/default/files/TM155.pdf.
[160] NOAA National Marine Fisheries Service. (2023). Fisheries Economics of the United States, 2020. U.S. Dept. of Commerce, NOAA Tech. Memo. NMFS-F/SPO-236. https://media.fisheries.noaa.gov/2023-02/FEUS-2020-final-03.pdf.

protein sources.[161] Certain types of sustainable aquaculture also have relatively low CO_2 emission levels, can contribute to carbon sequestration by growing carbon-rich products (e.g., seaweeds), and can also help support climate-ready conservation strategies by restoring depleted habitats, helping recover threatened and endangered species, and augmenting wild fisheries. Aquaculture already provides half of the global seafood supply. Internationally, more than 3 billion people depend on wild-caught and farmed seafood and freshwater fish for protein (a food security concern) and livelihoods, and this demand is increasing.

Challenges: **Building climate-ready fisheries, protected resources, aquaculture, and fishing communities requires information and tools to prepare for, be informed by, and respond promptly to the impacts of climate change on fisheries-related species (including endangered and threatened species, marine mammals, and other non-target species) and habitats, fishing sectors, and communities, and other sectors that may affect fisheries**.[162] Fishery managers, fishermen, and community leaders need near-term forecasts and longer-term projections of climate change impacts to identify risks and develop responses to both tomorrow's extreme events and longer-term changes, such as species and ecosystem range shifts. Considerable uncertainties surround long-term climate change impacts on fisheries, and there is the possibility for abrupt shifts in marine fish populations and marine ecosystems driven by increased frequency and severity of extreme events and ecological tipping points. Range shifts may be in response to ecosystem changes (e.g., prey availability, habitat loss) and may expose species to new threats and ecological conditions. This may limit the predictability for some fisheries, posing difficulties for monitoring systems and management decisions, and therefore, it is critical that the potential for rapid and unanticipated shifts is addressed. Relevant climate change impacts extend to the coasts, including wetland habitat loss and risks to working waterfronts from sea-level rise, inundation, and storm events. Additionally, climate change is likely to pose significant challenges to honoring place-based Tribal treaty rights.

Climate-driven geographic shifts in fish stocks alter the accessibility and logistics of fisheries for fishing communities. Fishery management is also impacted, particularly when fish stocks shift across domestic management boundaries (e.g., across U.S. Regional Fishery Management Councils, and across state and Federal boundaries) and internationally across nations' exclusive economic zones (EEZs) and within the high seas. Responsible, climate-ready fishery management will require preparation to anticipate geographic shifts and ensure the continuation of well-managed fish stocks with a sustainable biomass.[163] Finally, illegal, unreported, and unregulated (IUU) fishing could threaten to undermine progress on developing climate-ready and climate-informed fisheries, so it will be important to continue recent efforts on IUU in parallel.[164]

[161] Tsakirdis A., O'Donoghue C., Hynes S. et al. (2020). A comparison of environmental and economic sustainability across seafood and livestock product value chains. Marine Policy 117: 103968. https://doi.org/10.1016/j.marpol.2020.103968

[162] Link, J.S., Griffis, R., Busch S. (eds). (2015). NOAA Fisheries Climate Science Strategy. NOAA. https://spo.nmfs.noaa.gov/sites/default/files/TM155.pdf.

[163] Gaines, S.D., Costello, C., Owashi B. et al. (2018). Improved fisheries management could offset many negative effects of climate change. Science Advances 4(8). https://www.science.org/doi/10.1126/sciadv.aao1378

[164] In June 2022, President Biden signed the *National Security Memorandum to Combat Illegal, Unreported, and Unregulated Fishing and Associated Labor Abuses*, affirming that sustainable, responsibly harvested, and safe fisheries is an Administration priority. Also, the U.S. Interagency Working Group on IUU Fishing recently released the *National Five-Year Strategy for Combating Illegal, Unreported, and Unregulated Fishing (2022-2026)*, as required by the Maritime Safe Act, which will set the IWG's priorities and guide federal action, in partnership with relevant stakeholders.

Beyond commercial and recreational fisheries, climate change will also affect protected species covered under the Endangered Species Act and the Marine Mammal Protection Act. Many of these species, such as whales, now face significant challenges as their ecosystems undergo rapid changes in response to climate change. Monitoring, management, and protection decisions for these species need to incorporate climate change impacts and address limits to predictability in a changing future.

Progress: Progress has been made in forecasting (near-term) and projecting (longer-term) likely future ocean conditions for use in assessing risks and developing climate adaptation strategies for fisheries, aquaculture, and fishing communities. In FY 2023, NOAA will launch development of the nation-wide ocean prediction and decision-support system needed to assess risks, identify best strategies, and implement the actions needed for resilient marine resources and the communities that depend on them.[165] Additionally, agencies will continue to support ecosystem restoration, fisheries stock rebuilding, and protected species recovery efforts at regional scales. Now is the time to provide fishery decision makers with the tools to incorporate the science in real-time into climate-informed fishery management decisions at all lifecycle stages, support climate-ready aquaculture operations, promote climate-informed fishing community adaptation, and continue to combat IUU fishing. **The outcome will include fisheries management practices and fishing communities that are adaptable and resilient to the impacts of climate change and that enhance the overall resilience of the Nation's coastal communities and seafood system.**

OCAP Actions: Below is a summary of the Climate-Ready Fisheries and Fishing Communities OCAP Actions. For expanded details on these OCAP Actions, please see the Appendix, which lists responsible departments and agencies and projected timelines.

- **Provide marine resource decision makers and other ocean users with the information they need to assess risks and take action to adapt to changing ocean conditions**, including with implementation of the NOAA Climate, Ecosystems, and Fisheries Initiative (CEFI) decision support system. Key Agency: NOAA
- **Enable Regional Fishery Management Councils and other bodies with Federal nexus to incorporate climate-ready approaches into decision-making** by establishing clear goals, targets, and guidance for how climate resilience of fish stocks should be considered in management measures; furthering knowledge on alternate approaches to managing fisheries in a climate-changed world; promoting ecosystem-based fisheries management, adaptive fishery practices, and equitable implementation of flexible fishing portfolios; and implementing dynamic management systems. Key Agency: NOAA
- **Co-produce and deliver the products, tools, information, services and assistance to support climate-ready fishing communities** in assessing risks and taking actions to increase resilience and adapt to rapidly changing ocean conditions, with a focus on supporting highly vulnerable and underserved communities including Tribal Nations, Territories, and Indigenous Peoples. Key Agency: NOAA
- **Advance research, technologies, and observation systems to support climate-ready marine resources and communities** by better informing decision-making and continuous innovation in fisheries management, fishing community adaptation, and management of

[165] NOAA. (2021). NOAA Climate, Ecosystems, and Fisheries Initiative Fact Sheet. https://www.fisheries.noaa.gov/resource/document/noaa-climate-ecosystems-and-fisheries-initiative-fact-sheet. Last accessed March 2023.

protected resources and other ocean uses; increasing observing networks and data sharing on current ocean conditions; and expanding research on climate change impacts to coastal and marine ecosystems, fisheries, and protected species. Key Agencies: NOAA, NASA

- **Expand and decarbonize sustainable U.S. aquaculture production to enhance resilience of U.S. and global seafood system to the impacts of climate change** by using the best-available information on current and future ocean and coastal ecosystem conditions and increasing research, development, and application of sustainable aquaculture and aquaculture technologies powered by renewable energy that lowers emissions and minimizes and mitigates for damage to the marine environment to meet climate adaptation and mitigation goals. Key Agencies: NOAA, DOE, USDA
- **Identify, protect, and restore ocean and coastal habitats essential to climate-ready fisheries, protected species, and fishing communities** by researching and implementing best practices and benefits to fisheries, protected species, fishing communities, and carbon sequestration and storage. Key Agencies: USACE, NOAA, DOI/USGS
- **Explore research and development to transition to a climate-ready fishing fleet**, including on fishing vessel electrification conversion, low- and zero-emissions fishing vessels, and next-generation fishing technologies. Key Agencies: DOE, DOT, NOAA
- **As a tool for climate resilience, expand research that evaluates and advances the use and effectiveness of obsolete offshore infrastructure to develop and enhance artificial reefs** used for commercial and recreational fishing and recreational diving. Key Agency: DOI/BSEE
- **Reduce climate threats and improve the resilience of climate-vulnerable protected species, including marine mammals** by advancing research and monitoring technologies to support targeted protected marine mammal species management; using climate adaptation tools like vulnerability assessments and scenario planning to incorporate knowledge into climate-informed management plans; and building and strengthening national and international partnerships to ensure conservation and management of areas critical to protected species survival. Key Agencies NOAA, DOD/DON, DOI/BOEM, DOE, DOI/FWS
- **Enhance resilience of coral populations and coral reef systems with research and development of innovative techniques** to identify heat-resistant genotypes, reduce the mortality of corals, build partnerships to help conduct restoration at ecologically-meaningful scales, improve techniques that control the spread of coral diseases to help improve survival rates for corals at key reef sites, and implement and evaluate existing and emerging tools to forecast climate impacts and protect reefs by conferring resilience to impacts, e.g., by reducing more easily abatable stressors. Key Agency: NOAA, DOI

Coastal Climate Resilience

Objective: Prepare coastal communities for the impacts of climate change through coastal resilience projects informed by expanded Federal data, products, and information. Engage with stakeholders to ensure equitable access to climate information products and services and promote nature-based solutions where appropriate.

Background: Coastal regions, including marine and Great Lakes coastlines, are vital for the global economy, and their resilience is essential to a sustainable future. About 128 million Americans live in coastal communities in the United States alone, with the population steadily increasing.[166] These coastal communities produce more than $9.5 trillion in goods and services annually and employ up to 58.3 million people.[167] Coastal industries and communities also support the sustainable ocean economy, with key sectors in fishing and aquaculture (see previous section), recreation, tourism, shipping, ports, and defense.

While the coasts regularly face and recover from storms, waves, winds, and tides, climate change has increased the severity and frequency of impacts. Coastal communities and ecosystems are vulnerable to both natural hazards and human-made threats, which are further exacerbated by a changing climate. Chronic stressors include rising sea levels, warming, and acidification in coastal regions and increasingly rapid bi-directional fluctuations in water levels on the Great Lakes, and acute impacts include hurricanes, marine heatwaves, winter storms, invasive species, and harmful algal blooms.[168] Erosion and land loss along the Nation's marshes, beaches, dunes, barrier islands, and wetlands affects natural resources, energy, defense, public infrastructure, and tourism.[169]

At the same time, coastal ecosystems are also highly productive and foundational to life on Earth. For example, coastal habitats such as coral reefs, oyster reefs, and wetlands can reduce erosion, storm surge, inundation, and wave height, assist in mitigating climate change by sequestering and storing carbon, and can assist in protecting communities and infrastructure.[170] [171] While these habitats are generally highly adaptable, coastal areas need room to move, change, and respond, and concerted efforts are needed to increase their resilience, especially to the growing effects of climate change. Traditional hardened infrastructure and the dynamic nature of shorelines are in direct conflict at the coasts. Green infrastructure shorelines, like oyster reefs, coral, and wetlands, have the ability to adapt and continue to provide resilience as climate impacts worsen in a way that gray infrastructure cannot due to its static nature.

[166] NOAA Office for Coastal Management. Economics and Demographics. https://coast.noaa.gov/states/fast-facts/economics-and-demographics.html. Last accessed March 2023.
[167] Ibid.
[168] NOAA. SOST Coastal Resilience Workshop Summary Brief. https://www.noaa.gov/sites/default/files/2021-12/SOST%20Coastal%20Resilience%20Workshop_Public%20Summary%20and%20Agency_Interagency%20Participants%20List%20%281%29.pdf. Last accessed March 2023.
[169] US Commission on Ocean Policy. Managing Sediment and Shorelines. https://govinfo.library.unt.edu/oceancommission/documents/prelimreport/chapter12.pdf. Last accessed March 2023.
[170] Narayan, S., Beck M.W., Wilson, P. et al. (2017). The Value of Coastal Wetlands for Flood Damage Reduction in the Northeastern USA. Scientific Reports 7(9463). https://www.nature.com/articles/s41598-017-09269-z.
[171] Sheng, Y.P., Paramygin V.A., Rivera-Nieves, A.A. et al. (2022). Coastal marshes provide valuable protection for coastal communities from storm-induced wave, flood, and structural loss in a changing climate. Scientific Reports 12(3051). https://www.nature.com/articles/s41598-022-06850-z.

Challenges: Navigating Federal coastal resilience funding opportunities can be complex and time-consuming for communities with limited capacity. Additionally, finding and understanding the right programs, data, tools, and information needed to make informed decisions can be a barrier to effective coastal resilience projects. In coastal areas at risk of inundation and erosion from rising sea levels and storm surge, additional challenges exist for comprehensive adaptation techniques, such as relocation, even when there is existing community support. Additional barriers include a lack of aligned Federal policies and programs and coordinated Federal funding. **Improving coastal climate resilience will require connecting and augmenting existing Federal programs, and working closely with communities to build capacity and provide technical assistance**.

Progress: Executive Order 14008 on *Tackling the Climate Crisis at Home and Abroad* resulted in the creation of the National Climate Task Force's Coastal Resilience Interagency Working Group (CR-IWG) to enhance coordination on coastal resilience efforts.[172] In early 2022, the Interagency Sea Level Rise Task Force released its 2022 "*Sea Level Rise Technical Report*" with the most up-to-date sea level rise projections out to the year 2150 for the United States, including the U.S. Territories, along with an application guide to assist coastal decision-makers and professionals with applying and integrating the new projections.[173] Furthermore, both BIL and IRA provide funding for coastal resilience, climate adaptation, and restoration efforts along U.S. coastlines, including the Great Lakes. Many agencies are conducting and supporting research to better understand the impacts on coastal communities of coastal flooding, erosion, harmful algal blooms, invasive species, shifting distribution and abundance of marine species, ocean acidification, wetland loss, and sea level rise (or, in the case of the Great Lakes, potential fluctuations of water levels) and ways the resilience of coastal communities might be strengthened.

Nature-based solutions, such as restoring coastal habitats and creating living shorelines (a green infrastructure technique using native vegetation alone or in combination with low sills to stabilize the shoreline) are already being implemented and are a proven method for increasing community resilience,[174] and the lessons learned can be implemented and scaled up nationwide. The National Coastal Resilience Fund, a partnership between NOAA and the National Fish and Wildlife Foundation and other governmental and private sector partners, funds projects that cover the spectrum of nature-based infrastructure efforts. Since 2018, the National Coastal Resilience Fund has awarded 358 projects for a total investment of $733 million.[175] [176] The Fund invests in conservation projects that restore or expand natural features such as coastal marshes and wetlands, dune and beach systems, oyster and coral reefs, forests, coastal rivers and floodplains, and barrier islands that also serve to minimize the impacts of storms and other naturally occurring events on nearby communities.

Informed decisions in the coastal zone also depend heavily on accurate and up-to-date coastal mapping data. Federal agencies have worked with partners to develop a fine-scale, national valuation of the flood risk reduction benefits of coral habitats to people, property, economies, and

[172] NOAA. Coastal Resilience Interagency Working Group. https://www.noaa.gov/coastal-resilience-interagency-working-group. Last Accessed March 2023

[173] Sweet, W.V., B.D. Hamlington, R.E. Kopp, et al. (2022). Global and Regional Sea Level Rise Scenarios for the United States: Updated Mean Projections and Extreme Water Level Probabilities Along U.S. Coastlines. NOAA Technical Report NOS 01. https://oceanservice.noaa.gov/hazards/sealevelrise/noaa-nostechrpt01-global-regional-SLR-scenarios-US.pdf.

[174] NOAA National Ocean Service. What is a living shoreline? https://oceanservice.noaa.gov/facts/living-shoreline.html. Last accessed March 2023.

[175] NOAA. National Coastal Resilience Fund. https://coast.noaa.gov/resilience-grant/ Last accessed March 2023.

[176] Note that this estimate includes leveraged funds as well.

infrastructures.[177] The CR-IWG created a "Compendium of Federal Nature-Based Resources and Guidance for Coastal Communities, States, Tribes and Territories,"[178] which complements the National Roadmap on nature-based solutions.[179]

BOEM's Marine Minerals Program (MMP) partners with communities to address serious erosion along the Nation's coastal beaches, dunes, barrier islands, and wetlands. BOEM is the only agency with the authority to lease marine minerals from the OCS, and the MMP leases sand, gravel and shell resources from Federal waters for shore protection, beach nourishment, and wetlands restoration with vigorous safety and environmental oversight.

Finally, a new subcommittee of the CR-IWG on Community Driven Relocation was launched in fall 2022 to support the implementation of the BIL-supported Tribal community relocation program and work on a Federal framework for coordinated support for communities interested in relocation. With additional funding opportunities available through the IRA and the BIL, Federal agencies are seeking to collaborate with external stakeholders in addressing coastal resilience from many angles.

OCAP Actions: Below is a summary of the Coastal Climate Resilience OCAP Actions. For expanded details on these OCAP Actions, please see the Appendix, which lists responsible departments and agencies and projected timelines.

- **Promote coastal community resilience strategies that are adaptive, equitable, and based on best practices** by engaging with communities and regional scale partnerships to evaluate coastal resilience projects and share best practices, particularly in regard to nature-based solutions; providing technical assistance related to climate services and data to support community planning, with a focus on marginalized underserved and rural communities; improving accessibility of Federal coastal science-based tools and indices; and integrating Indigenous Knowledge and elevate Indigenous voices into coastal resilience research and management decisions. Key Agencies: BIA, DOE, EPA, FEMA, DOI/FWS, NOAA, OIA, USACE, DOI/USGS, DOT, DOD/DON
- **Through the CR-IWG subcommittee on Community-Driven Relocation, support demonstration projects on community-driven relocation and decision processes** by providing incentives and support to communities; investing in real time assessment and evaluation of demonstration projects; and creating an online integrated Federal resource page with information to support community-driven relocation. Utilize long-term trends, projections, and best practices to inform CDR decision making and evaluate impacts. Key Agencies: CEQ, DOI/BIA, DOI/USGS, EPA, FEMA, HUD, NOAA, USACE, USDA, DOT
- **Expand the range of coastal resilience and restoration project financing mechanisms available to frontline communities** with a focus on nature-based solutions, where appropriate, and in partnership with state, territorial, local governments, Tribal Nations,

[177] Storlazzi, C.D., Reguero, B.G., Cole, A.D. et al. (2019). Rigorously valuing the role of U.S. coral reefs in coastal hazard risk reduction: U.S. Geological Survey Open-File Report 2019–1027. https://www.usgs.gov/centers/pcmsc/value-us-coral-reefs-risk-reduction.
[178] The White House. (2022). Compendium of Federal Nature-Based Resources for Coastal Communities, States, Tribes and Territories. https://www.noaa.gov/sites/default/files/2022-11/V1.2-Nature-based-Solutions-Compendium-11822.docx.pdf. Last accessed March 2023.
[179] White House Council on Environmental Quality, White House Office of Science and Technology Policy, White House Domestic Climate Policy Office. (2022). Opportunities for Accelerating Nature-Based Solutions: A Roadmap for Climate Progress, Thriving Nature, Equity, and Prosperity. Report to the National Climate Task Force. https://www.whitehouse.gov/wp-content/uploads/2022/11/Nature-Based-Solutions-Roadmap.pdf.https://www.whitehouse.gov/wp-content/uploads/2022/11/Nature-Based-Solutions-Roadmap.pdf.

Indigenous Peoples, NGOs, the private sector, and faith-based organizations. Key Agencies: EPA, NOAA, DOI, DOE, USACE

- **Support transformational resilience investments in coastal habitat restoration and conservation and in community resilience** by using BIL and IRA funds to carry out projects that benefit coastal communities, including those that have been historically marginalized, underserved, or underrepresented; support to projects and communities should include technical assistance for making science-informed resilience investments, building enduring capacity, and engaging on the ground expertise to equitably reduce risk to coastal communities, economies, and ecosystems. Key Agencies: NOAA
- **Expand coastal mapping, monitoring, observational systems, research, and modeling to inform science-based decision-making capabilities and advance use of nature-based solutions** by fostering community engagement and feedback on climate vulnerability assessments and tools; co-designing systems with local governments, management agencies, and other stakeholders; ensuring that Federal mapping, science tools and services are integrated across agencies and responsive to the needs of coastal communities, and agencies that fund coastal resilience; and fully integrating green infrastructure and nonstructural flood risk reduction in feasibility studies for Federal flood risk management infrastructure. Use new technologies, such as those provided through satellites, to better assess flood inundation and to provide improved flood extent data records. Key Agencies: DOI, DOI/USGS, DOI/FWS, EPA, HUD, NASA, NOAA, USACE, USDA
- **Advance evaluation and adoption of nature-based solutions, such as living shorelines, to build resilience against climate-driven coastal hazards** through existing interagency programs such as the National Oceanographic Partnership Program (NOPP); the National Coastal Resilience Fund; new Coastal Resilience test beds for current and novel coastal hazard mitigation and adaptation strategies; innovation in coastal mapping, engineering practices and standards; and using nature-based solutions in disaster recovery programs. Key Agencies: EPA, NOAA, DOI/NPS, ONR, USACE, DOI, DOI/USGS, DOI/BOEM, DOD/DON
- **Expand Federal assistance through voluntary habitat conservation programs** by working directly with coastal communities and established partnerships to implement projects that build coastal resilience; identify barriers to community engagement and participation in habitat conservation; develop resources that promote inclusive conservation solutions; and monitor conservation action to assess effectiveness. Key Agencies: EPA, DOI/FWS, NOAA
- **Enhance community resilience through the National Coastal Resilience Fund** to restore, increase, and strengthen natural infrastructure to protect coastal communities while also enhancing habitats for fish and wildlife. Key agencies: NOAA, DOD.
- **Reduce threats to coastal and Great Lakes ecosystems that are exacerbated by climate change, including invasive species and harmful algal blooms** by expanding modeling and monitoring efforts; advancing experimental forecasts into operations; developing methods for invasive species detection and monitoring; and investigating ecological impacts of climate change threats. Key agency: NOAA

Conclusion

Recognizing the climate crisis as one of our nation's–and the world's–most pressing challenges, the Biden-Harris Administration has led a sea change for integrated domestic clean energy development, ecosystem conservation and restoration, job creation, and climate resilience.

The Ocean Climate Action Plan builds on existing efforts to establish the first comprehensive U.S. strategy to use the power of the ocean and coasts to address and respond to climate change. The OCAP actions further Administration priorities focused on tackling climate change, advancing racial equity and justice, and bolstering the U.S. economy.[180]

U.S. Federal agencies are well prepared to begin implementing the new actions detailed in this Plan and to continue the ongoing actions. Bipartisan support will be critical to the resourcing and long-term support of these actions. Federal agencies will seek public, State, Territorial, and Tribal engagement in the implementation of these actions, and look to the broader community for their expertise, perspectives, needs, and interests in the continued implementation of this Plan. We must act now on ocean climate solutions to secure an equitable, safe, and prosperous future for generations to come.

[180] The White House. The Biden-Harris Administration Immediate Priorities. https://www.whitehouse.gov/priorities/. Last accessed March 2023.

Scientific Background

Climate change is already affecting the U.S. ocean, coasts, and the Great Lakes, as well as adjacent interior land areas that interact closely with the ocean. The past half century is marked by rapid and global-scale climate change that is due unequivocally and almost entirely to human emissions of heat-trapping greenhouse gases (GHGs) and climate-active aerosols.[181] The predominant GHG, carbon dioxide (CO_2), is released to the atmosphere largely from fossil fuel combustion and land-use change and is only slowly removed by natural processes. As a result, excess CO_2 accumulates in the atmosphere and in the ocean, leading to climate and ocean warming and ocean acidification that lasts centuries or longer into the future. Other potent GHGs, including methane (CH_4), nitrous oxide (N_2O), and halogenated carbon compounds are released to the atmosphere directly from industrial and agricultural sources; human-driven climate change also affects, and in some cases increases, emissions of CH_4 and N_2O from natural ecosystem sources. Further climate change and global warming are projected to worsen in the coming decades because of ongoing human GHG emissions.

Present-day global average surface temperatures are about 1.1°C above a pre-Industrial baseline. The current level of climate change is already affecting human health and well-being through shifts in weather extremes, like more frequent heat waves, alterations of the water cycle, melting of glaciers and ice-sheets, impacts on agriculture and fisheries, and damage to communities and infrastructure from intense flooding and rising sea levels.[182] Without accelerated efforts to reduce CO_2 and other GHG emissions, the world is on a path this century to further warming from 2.4 to 2.6°C above pre-Industrial levels.[183] In order to avoid the most severe and devastating effects of climate change, the science suggests limiting the global temperature increase in this century to 2.0°C, while pursuing efforts for a more stringent 1.5°C limit—the levels agreed to in the Paris Climate Accords. This raises the urgency for climate mitigation efforts to reduce and eventually eliminate further GHG emissions through decarbonizing the energy, transportation, and industrial systems, improving energy efficiency, shifting agricultural and land-use practices, and carbon capture and sequestration (CCS) methods. Carbon dioxide removal (CDR) of CO_2 from the atmosphere will also be needed alongside CCS to offset GHG emissions from some difficult to abate sectors.

The Biden-Harris Administration has set ambitious, economy-wide goals of reducing GHG emissions 50-52% below 2005 levels by 2030 and to net-zero by 2050 through a series of unprecedented climate actions.[184] Ocean-based actions can contribute to these goals by further reducing GHG emissions and enhancing carbon uptake and storage in coastal and marine ecosystems. In our assessment, there is no path to net-zero without the ocean. Ocean climate mitigation helps avoid unmanageable levels of climate change impacts in the future. A recent report by the High Level Panel for a Sustainable Ocean Economy found that a subset of ocean-based mitigation solutions could provide as much as 21% of the

[181] U.S. Global Change Research Program, Fourth National Climate Assessment (2018), https://www.globalchange.gov/nca4; Intergovernmental Panel on Climate Change, 6th Assessment Report (2021-2022), https://www.ipcc.ch/assessment-report/ar6/.
[182] U.S. Global Change Research Program, Fourth National Climate Assessment (2018), https://www.globalchange.gov/nca4; Intergovernmental Panel on Climate Change, 6th Assessment Report (2021-2022), https://www.ipcc.ch/assessment-report/ar6/.
[183] United Nations Environment Programme (2022). Emissions Gap Report 2022: The Closing Window — Climate crisis calls for rapid transformation of societies. https://www.unep.org/emissions-gap-report-2022.
[184] The White House. FACT SHEET: President Biden Sets 2030 Greenhouse Gas Pollution Reduction Target Aimed at Creating Good-Playing Union Jobs and Securing U.S. Leadership on Clean Energy Technologies. (April 21, 2021). https://www.whitehouse.gov/briefing-room/statements-releases/2021/04/22/fact-sheet-president-biden-sets-2030-greenhouse-gas-pollution-reduction-target-aimed-at-creating-good-paying-union-jobs-and-securing-u-s-leadership-on-clean-energy-technologies/ Last accessed March 2023.

global emissions reductions needed to meet a 1.5°C target by 2050.[185] Decarbonization of the marine transportation system and replacement of fossil fuel electricity generation through low- or no-CO_2 emission renewable energy from offshore winds, waves, and tides are examples of ocean-based emission reduction strategies. Carbon capture technologies from energy and industrial point sources can be linked to sequestration of CO_2 in sub-seabed geologic formations. Other ocean mitigation actions focus on nature-based solutions that prevent further emissions, or even increase CO_2 uptake from the atmosphere, by protecting and restoring carbon-rich blue carbon coastal and ocean ecosystems. Marine conservation, fishery, and aquaculture climate actions may also contribute to carbon mitigation efforts. Finally, the IPCC has determined that carbon dioxide removal (CDR) will be needed to extract an estimated 10 Gt of CO_2 per year by 2050 and 20 Gt of CO_2 per year by 2100 in order to stay within the 1.5°C limit.[186] Safe and effective ocean or marine CDR would contribute to this global total removal and includes a range of approaches that could further remove and store carbon in the ocean water column, biota, and sediments. Any marine CDR would be in addition to the large natural ocean uptake of excess atmospheric CO_2 that is already occurring, currently at a rate of 10 Gt of CO_2 per year.[187]

Ocean climate mitigation actions must be complemented by climate adaptation actions that reduce the risks and damages to people and the environment from the changes that are already occurring and will worsen as global surface temperatures continue to rise as projected over the next several decades. The most visible climate impacts for the public are often land-based, such as flooding, droughts, or wildfires, considering where most people live and work. Equally important, however, are the less visible effects of climate change on the coasts, ocean, and the ocean economy. This is particularly true for climate change threats to valuable marine resources and the many communities that depend on them – a strong motivation for accelerated action on ocean-based climate adaptation measures. A portfolio of effective solutions should span across land-water boundaries, recognizing the strong interactions of coasts and the ocean with adjacent interior land regions. Healthy ocean ecosystems may buffer some aspects of climate change while also delivering important natural services from seafood to coastal protection from storms and flooding. Specific adaptation actions considered in this report include marine protected areas, climate ready fisheries and fishing communities and aquaculture, coastal resilience, and protection and restoration of blue carbon habitats.

Adaptation strategies will build upon a solid scientific understanding of ocean climate change and its impacts. Despite the ocean's vast size - more than 70% of the planet's surface, and the largest livable habitat - we know from decades of observations from ships, autonomous instruments, and satellites how climate change is rapidly altering ocean physics, chemistry, and biology on global, regional, and local scales.[188] [189] [190] Because the ocean surface warms somewhat more slowly than land, global average

[185] Hoegh-Guldberg, O., Caldeira K., Chopin. T. et al. (2019). The Ocean as a Solution to Climate Change: Five Opportunities for Action. World Resources Institute. https://oceanpanel.org/wp-content/uploads/2022/06/HLP_Report_Ocean_Solution_Climate_Change_final.pdf; Hoegh-Guldberg, O., Northrop, E. & Lubchenco, J. (2019). The ocean is key to achieving climate and societal goals. *Science* 365(6460): 1372-1374 https://www.science.org/doi/10.1126/science.aaz4390.

[186] IPCC. (2022). Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. https://www.ipcc.ch/report/sixth-assessment-report-working-group-3/.

[187] Global Carbon Project. (2022). Carbon budget and trends 2022. https://www.globalcarbonproject.org/carbonbudget/index.htm.

[188] U.S. Global Change Research Program, Fourth National Climate Assessment (2018), https://www.globalchange.gov/nca4; Intergovernmental Panel on Climate Change, 6th Assessment Report (2021-2022), https://www.ipcc.ch/assessment-report/ar6/.

[189] IPCC. (2021). Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. https://www.ipcc.ch/report/sixth-assessment-report-working-group-i/.

[190] IPCC (2022). Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. https://www.ipcc.ch/report/sixth-assessment-report-working-group-ii/.

sea surface temperature has increased since the beginning of the 20th century by about 0.88°C. Marine heatwaves, an ocean form of weather extremes, are becoming more frequent and intense, affecting weather, marine life, fisheries, and aquaculture. The warming is causing a poleward shift of many marine species, which impacts the location and stock size for fisheries. Ocean warming can exacerbate existing ecological hazards, such as expansion in the occurrence of some marine organism diseases and harmful algal blooms. Marine heatwaves and other ocean extreme events are causing more extensive tropical coral bleaching and other ocean ecological disruptions. Rapid Arctic warming and ice-albedo-related climate feedbacks are driving a substantial decline in seasonal sea-ice extent and thickness, with wide ramifications for marine and coastal ecosystems, coastal infrastructure and communities, national security, and transportation. Additionally, climate change is altering the character of extreme weather events such as tropical storms and intense extratropical cyclones that affect coastal habitats and communities.

Warming is not isolated to the sea surface, with increasing water temperatures extending through the upper kilometer of the water column. The ocean provides a valuable climate service by absorbing about 90% of the excess heat from global warming and thus slowing the pace of climate change and surface warming. These ocean climate services from heat and CO_2 uptake, however, come at a cost. Excess CO_2 alters the chemistry of seawater and threatens marine life (see Box: Ocean Acidification). Ocean warming and altered wind patterns change ocean vertical stratification and physical circulation, which in turn affect nutrient supplies for phytoplankton at the base of the marine food web. Warming seawater and shifts in ocean currents lead to a decline in subsurface ocean oxygen levels, in some cases restricting the vertical habitat range for marine life. Stronger coastal upwelling due to increased winds along the coast, another consequence of climate change, is even causing extreme hypoxic (low-oxygen) events on some continental shelf regions. The increase in ocean heat content causes seawater expansion, and the combination of ocean warming and glacier and ice-sheet melting results in global sea-level rise that is elevating flooding risks along many coastlines.

The negative consequences of climate change are and will be felt non-uniformly across the Nation, with disproportionate harm to Black, Latino, Indigenous, and low-income and marginalized communities.[191] The Biden-Harris Administration has set out a groundbreaking goal to deliver 40% of the benefits from Federal investments in climate and clean energy to disadvantaged communities.[192] Accordingly, ocean climate actions must integrate environmental justice and equity considerations into mitigation and adaptation solutions and be informed by local and Indigenous Knowledge.[193]

[191] EPA. (2021). Climate Change and Social Vulnerability in the United States: A Focus on Six Impacts. EPA 430-R-21-003. https://www.epa.gov/cira/social-vulnerability-report.

[192] Exec. Order 14008, Tackling the Climate Crisis at Home and Abroad, https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/27/executive-order-on-tackling-the-climate-crisis-at-home-and-abroad/, *reprinted in* 86 Fed. Reg. 7619 (Feb. 1, 2021).

[193] Defined as a body of observations, oral and written knowledge, innovations, practices, and beliefs developed by Tribes and Indigenous Peoples through interaction and experience with the environment.

Appendix with Expanded Details on Ocean Climate Actions

The Ocean Climate Action Plan (OCAP) summarizes the high-level ocean climate actions needed to support the goals to *Achieve a Carbon-Neutral Future*, *Accelerate Nature-Based Solutions*, and *Enhance Community Resilience to Ocean Change.* This Appendix provides additional information for how to advance each of the ocean climate actions and expected timeframes. The Appendix also addresses the other OCAP priorities, called out in boxes in the text, of supporting ocean research, observations, and forecasting, and addressing ocean acidification, along with the expected timelines. The timelines are current estimates that will be refined with time as OCAP efforts progress.

Ocean-based solutions to the climate crisis must be comprehensive and coordinated across historical disciplinary and geographic silos. Accordingly, the ocean climate actions rarely fit within the mission of a single Federal department or agency. **Successful development and implementation of ocean climate actions will require integrated and coordinated action across the Federal Government, in partnership with Tribal Nations, Indigenous Peoples, States, U.S. Territories, communities, the private sector, and civil society.** Therefore, the expanded details below list the lead and supporting Federal Departments, Agencies, and Bureaus working on these actions either independently or as part of interagency efforts, and highlight opportunities to work with other partners, stakeholders, and communities. Increasing interagency coordination and outreach beyond the Federal Government on ocean climate actions is an important component of the OCAP.

The headings below correspond to the order each concept is addressed in the OCAP. The headings restate each OCAP priority or OCAP action, and the bolded text repeats the high-level action needed, as introduced in the main body of the plan. The sub-bullets provide the additional details for how to implement these priorities and actions.

Cross-Cutting Principles and Actions

The following cross-cutting principles and actions are crucial to integrate knowledge, engagement, and implementation across all of the ocean climate action themes included in the OCAP and will ensure that agencies continue to advance the Biden-Harris Administration's commitment to equity, justice, engagement, and meaningful participation in Federal decision making.

- **Ocean Health and Stewardship**
  - OPC and Departments, Agencies, and Bureaus carrying out the ocean climate actions will include a focus on ocean health and stewardship in all of their activities (Timeframe: Immediate)

- **Environmental Justice**
  - OPC will develop an Ocean Justice Strategy that will identify barriers and opportunities to fully integrate environmental justice principles into the Federal Government's ocean activities (Timeframe: 6 months to complete)

- **Engage with Tribal Nations and Indigenous Peoples**
  - OPC and its member agencies commit to early, frequent, and meaningful engagement with Tribal Nations, including through formal Nation-to-Nation Tribal Consultation, and other engagement with Indigenous Peoples, in the actions that stem from the OCAP (Timeframe: Immediate)
  - OPC and its member agencies will explore innovative funding mechanisms to improve access to Federal funds for Tribal Nations and Indigenous Peoples, including for research, monitoring, and workforce development (Timeframe: initiate within 6 months)

- **Outreach and Engagement**
  - OPC will establish a mechanism for engaging Federal, Tribal, State and Territorial agencies, local governments, the private sector, academia, non-governmental organizations (NGOs), and the public – to support participation in OPC initiatives, in partnership with the National Oceanographic Partnership Program, the Ocean Research Advisory Panel, and the National Ocean Mapping, Exploration, and Characterization Council (Timeframe: initiate within 6 months)

- **Science, Evidence, and Knowledge**
  - Building on the Administration's ocean science and technology priorities, the OPC's Subcommittee on Ocean Science and Technology will develop recommendations for Federal research priorities specific to the OCAP themes to help guide Federal, academic, and private sector research and engagement (Timeframe: within 6 months)
  - The OPC will support the Biden-Harris Administration's *Year of Open Science* in 2023, which aims to advance national open science policy, provide access to the results of the nation's taxpayer-supported research, accelerate discovery and innovation, promote public trust, and drive more equitable outcomes. (Timeframe: Immediate)

  - The OPC and its member agencies will commit to including input from Tribal Nations, as well as from Indigenous Peoples and Indigenous Knowledge in decisions about the ocean (Timeframe: Immediate)

- **Interagency Coordination**
  - Successful development and implementation of ocean climate actions will require integrated and coordinated action across the Federal Government – such as that provided by the OPC– in partnership with Tribal Nations, Indigenous Peoples, States, Regional Fishery Management Councils and other bodies, U.S. Territories, communities, the private sector, and civil society (Timeframe: Immediate)

OCAP Priority— Support Ocean Research, Observations, Modeling, Forecasting and Synthesis

Objective: Advance ocean and climate science to support ocean climate action

- **Prioritize Federal research specific to the OCAP themes** to help guide Federal, academic, and private sector research and engagement
    - All Federal Departments and Agencies working at the intersection of ocean and climate science should prioritize Federal research to help guide advances in ocean climate actions on an ongoing basis (Timeframe: Immediate)

- **Support formal and ongoing mechanisms for engaging multi-sectoral representatives -** including Federal, Tribal, State and Territorial agencies, the private sector, academia, NGOs, regional organizations, and the public – to facilitate participation in government-wide ocean science initiatives
    - All Federal Departments and Agencies working at the intersection of ocean and climate science should support broad participation in ocean science initiatives on an ongoing basis (Timeframe: launch within 6 months – to become regular practice)

- **Maintain and expand ocean basic and applied research, observing networks, modeling, forecasting, synthesis, and technology development** to support and advance ocean climate solutions
    - Accelerate understanding of the changing global ocean and its potential role in future climate change (Key Agencies: NOAA, NASA, Support: NSF, DOD/DON, DOE, DOI/BOEM, USCG, EPA, DOI/BSEE, DOI/NPS, DOI/USGS; Timeframe: Immediate).
    - Provide the scientific context of a changing ocean for research on evaluating the benefits and risks of ocean climate solutions (Key Agencies: NOAA, DOE, DOD, NASA, EPA; Support: NSF, DOD, DOE, DOI/BOEM, USCG, DOI/BSEE, DOI/NPS, DOI/USGS; Timeframe: Near-term (6 months) to launch).

- **Identify opportunities to co-locate ocean climate solutions** at targeted locations to leverage common resources and reduce barriers for ocean solution research and evaluation (Key Agencies: NSF, DOE, DOD, NOAA, EPA; Support: DOD/DON, DOI/BOEM, DOI/BSEE, DOI/NPS, NASA, USCG, DOI/USGS; Timeframe: Initiate within 12-18 months)
    - Identify opportunities for testing/demonstration sites for co-development and co-location of multiple ocean climate solutions; in choosing sites, consider variation across marine ecosystems, levels of ocean conservation/protection status, and strategy for operation, equitable access, and sustainability
    - Create sites leveraging existing ocean observing and other coastal/ocean infrastructure involving industry, States, Tribes, regional and local governments, NGOs, regional organizations, philanthropy, and other stakeholders
    - Create common measuring, monitoring, reporting, and verification (MMRV) approaches for evaluating benefits and risks of multiple ocean climate solutions
    - Use sites to develop integrated and sustainable ocean climate solutions by embracing systems thinking and transdisciplinary approaches

- **Develop new and innovative technologies and information pathways for ocean climate action by tapping into diverse expertise and perspectives**
    - Identify the technological and information challenges for implementing ocean climate actions through expert elicitation, cross-disciplinary workshops, and public engagement. Design and develop solutions to these challenges using workshop, grant funding, and competition approaches that emphasize creativity, collaboration, and inclusion of multiple perspectives; examples could include, but not limited to, the National Oceanographic Partnership Program (NOPP), Ideas Lab concept,[194] National Academies Keck Futures Initiative-Collaborations of Consequence,[195] and the Small Business Innovation Research (SBIR) programs.[196] (Key Agencies: NOAA, NASA, DOE; Support: DOI/USGS, NSF, NOPP, SOST. Timeline: Mid-term (1-2 years)).

[194] Ideas Lab refers to an NSF workshop format that brings together multiple diverse perspectives in an intensive interactive setting to focus on finding innovative cross-disciplinary solutions to a grand challenge problem.
[195] National Research Council. (2018). Collaborations of Consequence: NAKFI's 15 Years Igniting Innovation at the Intersections of Disciplines. https://doi.org/10.17226/25239.
[196] The SBIR and STTR Programs. https://www.sbir.gov/about. Last accessed March 2023.

Offshore Wind and Marine Energy Actions to Advance a Carbon Neutral Future

The OCAP includes the following objective for relying on offshore wind and marine energy*:*

Objective: Meet the Biden-Harris Administration's goal to deploy 30 GW of offshore wind by 2030, 15 GW of floating offshore wind by 2035,[197] and to rapidly and responsibly advance the commercialization of marine energy technologies that convert energy from waves, tides, currents and other ocean sources.[198] Expand offshore wind and marine energy as an alternative to higher-emitting energy resources in order to meet the Administration's broader goal to reach 100 percent carbon pollution-free electricity by 2035 and net-zero greenhouse gas emissions economy-wide by no later than 2050. [199]

To meet this objective, the OCAP sets forth the following high-level actions in bold, which can be advanced through the additional efforts and strategies described in more detail below. The efforts presented here reflect a subset of broader activity underway across Federal agencies, coordinated by the White House Climate Policy Office with support from across the Executive Office of the President.

- **Expand offshore wind and marine energy in an environmentally responsible manner that considers the needs of all users of those lands, coasts, and waters**
    - Ensure the path forward for future offshore wind leasing by publishing an Offshore Wind Leasing Schedule that establishes a succession of lease sales to achieve the Biden-Harris Administration's goal to deploy 30 gigawatts (GW) of offshore wind energy capacity by 2030, as well as 15 GW of floating offshore wind by 2035. The Strategy will establish transparency and confidence in the offshore wind industry and drive the development of a robust domestic supply chain and the creation of a resilient clean energy sector that will combat climate change and create well-paying jobs. (Key Agencies: DOI/BOEM; Timeframe: Immediate, to be updated at least once every two years)
    - Maximize efficiencies in the preparation of a robust environmental and socioeconomic review process by ensuring effective Federal interagency coordination to accelerate ocean renewable energy decision-making and provide needed environmental protection. (Key Agencies: DOI/BOEM, FPISC, CEQ; Support: DOI/BSEE, DOD/DON, DOE, NOAA, EPA, USACE, USCG; Timeframe: Immediate to become regular practice)
    - Further increase coordination across Federal, state, and local governments, Insular Area communities, Tribal communities, industry, and other key players for sharing of data to better inform permitting, grid planning, and infrastructure to streamline

[197] The White House, FACT SHEET: Biden-Harris Administration Announces New Actions to Expand U.S. Offshore Wind Energy (Sept. 15, 2022), https://www.whitehouse.gov/briefing-room/statements-releases/2022/09/15/fact-sheet-biden-harris-administration-announces-new-actions-to-expand-u-s-offshore-wind-energy/.

[198] The Biden-Harris Administration offshore wind goals do not apply to the Great Lakes, where the authority to develop offshore wind capacity lies with the Great Lakes States.

[199] The White House, FACT SHEET: President Biden Sets 2030 Greenhouse Gas Pollution Reduction Target Aimed at Creating Good-Paying Jobs and Securing U.S. Leadership on Clean Energy Technologies (April 22, 2021), https://www.whitehouse.gov/briefing-room/statements-releases/2021/04/22/fact-sheet-president-biden-sets-2030-greenhouse-gas-pollution-reduction-target-aimed-at-creating-good-paying-union-jobs-and-securing-u-s-leadership-on-clean-energy-technologies/. Last accessed March 2023.

offshore wind project development and grid connection. (Key Agencies: DOI/BOEM, DOE; Support: DOI/BSEE, NOAA, USCG, DOI/USGS; Timeframe: Immediate)

- Support the technology and services to collect, curate, maintain, and distribute authoritative baseline data for areas that are undergoing Area Identification for offshore wind leasing to support accelerated identification of sites that are suitable for cable routes and infrastructure placement in both nearshore and offshore waters. Ensure all non-proprietary collected data are available to the public through the Marine Cadastre to support environmental and technological research efforts. (Key Agencies: DOI/BOEM, NOAA, Support: USCG, DOE, DOI/BSEE, DOI/USGS; Timeframe: Ongoing)

  - Advance reforms and rulemaking that would update existing renewable energy regulations to help facilitate the timely and responsible development of ocean renewable energy resources on the Outer Continental Shelf (OCS). (Key Agencies: DOI/BOEM/BSEE; Timeframe: Immediate to become regular practice)
  - Increase scientific research and knowledge on the potential impacts of offshore wind and marine energy development and production on ocean and coastal resources such as seabirds, marine mammals, fisheries and fish habitat, local and regional oceanic processes (e.g., currents, temperature stratification), marine acoustics, and cultural resources to inform policy decisions through Tribal, academic, and public-private partnerships, and to other ocean co-users, in particular national security equities. (Key Agencies: DOI/BOEM, DOE, NOAA; Support: DOI/BSEE, DOI/USGS, Oceanographer of the Navy, DOD/DON; Timeframe: Ongoing)
  - Research, develop, and implement measures to mitigate offshore wind turbine interference to radar systems and prevent conflicts with radar missions related to air traffic control, weather forecasting, ocean observing, homeland security, and national defense. (Key Agencies: DOD, DOE, FAA, NOAA, DOI/BOEM; Support: DHS/USCG; Timeframe: Ongoing)
  - In line with CEQ's January 2023 *Interim NEPA Guidance on Greenhouse Gas Emissions and Climate Change*, agencies should use the best-available science to assess how climate change may affect the relevant affected environment and proposed offshore wind development including, for instance, by using available climate models to assess projected changes to wind or weather patterns. (Key Agencies: DOI/BOEM, NASA, CEQ. Timeframe: Ongoing)

- **Address transmission challenges to facilitate the United States achieving its offshore wind targets**
  - Examine the challenges associated with transmission that may be potential barriers to meeting U.S. offshore wind targets, such as knowledge gaps on impacts to the marine environment, project cost and benefit allocation, and potential onshore transmission congestion, and develop a recommendations report to identify coordinated solutions to address these challenges. (Key Agencies: DOI/BOEM, DOE; Support: FERC; Timeframe: 6 months)
  - Ensure effective coordination in implementing report recommendations and advancing intra-regional and inter-regional transmission solutions in alignment with Federal transmission reforms and recommendations. (Key Agencies: DOI/BOEM, DOE, FERC; Support: NOAA, FPISC, USACE, DOD/DON, DOI/BSEE; Timeframe: 0-6 months after publication of recommendations report)

        - Ensure coordination efforts include robust engagement with government partners, local communities, Tribal nations, ocean users, regional ocean partnerships, and key stakeholders, and facilitate transparent, sustainable, and equitable transmission planning and siting.

- **Support innovation in offshore wind and marine energy technologies by expanding research and development**
    - Increase research that supports the design, development, testing, and demonstration of technologies that can capture energy from wind, waves, tides, currents, and salinity, thermal and pressure gradients.
        - For marine energy, this research includes resource characterization, next-generation technology design, demonstration and pilot projects, the development and testing of new materials, and the creation of instrumentation, modeling, and simulation tools to enable real-condition testing of these technologies (Key Agency: DOE; Support: DOI/BOEM, DOI/BSEE, NOAA; Timeframe: Immediate and Ongoing)
        - For fixed-bottom and floating offshore wind systems, including improved resource modeling; up-scaling of turbines through systems engineering and new materials discovery; design for U.S. weather conditions; and manufacturing, operations, and maintenance research and development. Fixed-bottom research includes alternative installation methods and noise reduction practices, while floating research includes platform design and serial manufacturing, mooring and anchoring solutions, and floating substations. (Key Agencies: DOE, DOI/BSEE; Support: DOI/BOEM, NOAA; Timeframe: Ongoing)
    - Commission research that informs the feasibility to convert obsolete offshore oil and gas infrastructure for offshore wind and marine energy uses. This research includes defining risks, liabilities, and other issues and identifying potential standards and mitigations for safe and environmentally-sound repurposing. (Key Agencies: DOE, DOI/BSEE; Support: DOI/BOEM, NOAA, NSF; Timeframe: Ongoing)
    - Increase research on socioeconomic impacts, including impacts to Tribal Nations, workers, and disadvantaged groups, to ensure equity and environmental justice considerations are taken into account during planning and development of marine energy and offshore wind. (Key Agency: DOI/BOEM; Support: DOE, NOAA, NSF; Timeframe: Ongoing)
    - Increase research to develop technologies that optimize the performance and reliability of offshore wind transmission technologies, such as critical cables (HVDC), substations, and other electrical infrastructure. (Key Agency: DOE; Timeframe: Immediate (Initiate within 6 months)

- **Improve ports, U.S. ships, and domestic supply chains to facilitate offshore wind deployment**
    - Promote a domestic supply chain through Federal policy, investment and coordination, as well as interstate coordination. (Key Agencies: DOI/BOEM, DOT, USACE, DOE; Support: NOAA; Timeframe: Immediate)

- In coordination with the energy sector, use Federal resources, such as those provided through BIL, IRA, and others, to assist in upgrading port facilities infrastructure to accommodate for increasing offshore wind industry needs, such as large staging areas, cranes, fabrication facilities, dock space for wind energy vessels, and operations and management spaces. (Key Agencies: DOT, USACE; Support: MARAD, DOI/BOEM, USCG, DOE; Timeframe: Immediate)
- Incentivize the production of U.S. wind turbine installation vessels and other needed offshore wind support vessels through new policy and funding mechanisms. (Key Agencies: DOE, DOT; Support: DOI/BOEM; Timeframe: Immediate)

- **Foster partnerships focused on training the workforce needed to rapidly expand and maintain offshore wind energy and marine energy development**
  - Bolster technical, scientific, and research capabilities through workforce development programs in order to meet the growing needs of the offshore wind and marine energy sector. (Key Agencies: DOE; Support: NSF, USCG, DOI/BOEM/BSEE, NOAA; Timeframe: Launch immediately to become regular practice)
  - Explore the possibility of establishing offshore wind Centers of Excellence that will create partnerships with educational institutions of all kinds to identify workforce skill requirements for offshore energy development, develop coursework and credentialing systems, and recruit workforce participants from historically marginalized communities and coastal regions. (Key Agency: DOE; Support: DOI/BOEM; Timeframe: Initiate within 0-3 months)
  - Study the current state of ocean acoustics education and training and report on the needs for a strengthened ocean acoustics workforce, including industry (Key Agency: DOD/DON; Support: NOAA, DOI/BOEM; Timeframe: Ongoing)

- **Investigate the potential of offshore wind and marine energy to power applications in and beyond the sustainable ocean economy**
  - Enable coupled wind or marine energy-storage systems to allow for their wide-spread adoption through techno-economic analysis of offshore, or onshore storage. Analysis will inform cost-effective deployment and research and development to advance coupled storage systems and extend their use cases and performance in different power markets. (Key Agency: DOE; Support: DOI/BOEM, DOI/BSEE; Timeframe: Long-term)
  - Support continued technology development for marine energy-powered desalination devices capable of providing drinking water for coastal and island communities as well as for disaster relief/emergency response applications and resilience planning. (Key Agency: DOE; Support: USCG, FEMA)
  - *Shared Action (Green Shipping):* Investigate the requirements of and make recommendations for offshore wind production and storage of green hydrogen to electrify various sectors including Marine Transportation System. (Key Agencies: DOI/BOEM, DOE; Support: USCG, MARAD, NOAA; Timeframe: Long-term (2-5 years))
  - *Shared Action (marine CDR):* Assess additional potential uses of marine energy sites, including to power in-situ ocean and atmosphere observing platforms and marine CDR technologies. (Key Agencies: DOE, DOI/BOEM, EPA; Support: NOAA, USCG; Timeframe: Launch within 6 months to become regular practice)

- *Shared Action (Climate Ready Fisheries and Fishing Communities)*: Explore the potential for co-use of marine energy and offshore wind sites with aquaculture infrastructure and production sites as well as marine energy-powered environmental monitoring. (Key Agencies: USDA, NOAA, DOE, DOI/BOEM, EPA, USACE; Support: USCG; Timeframe: Launch within 6 months)

- **Facilitate the responsible deployment of offshore wind globally**
  - Continue to engage bilaterally and multilaterally with foreign governments to inform and mutually benefit domestic offshore wind regulatory and investment practices. (Key Agencies: DOI/BOEM/BSEE, DOE, State/SPEC, NOAA; Timeframe: Ongoing)
  - Continue to provide technical assistance bilaterally to emerging offshore wind markets in line with U.S. foreign policy objectives, sharing strategies for different phases of offshore wind development, as well as lessons learned in different national contexts. (Key Agencies: DOI/BOEM/BSEE, State/SPEC, NOAA; Timeframe: Ongoing)
  - Engage governments, private sector actors from across the offshore wind energy value chain, and international organizations through the Global Offshore Wind Alliance (GOWA), established in 2021 with 10 countries, the International Renewable Energy Agency, the International Energy Agency, and Global Wind Energy Council. GOWA will provide a new and supplementary platform for providing technical assistance to emerging offshore wind markets. (Key Agencies: DOI/BOEM, State/SPEC; Support: DOI/BSEE, DOE; Timeframe: Ongoing)

Green Maritime Shipping Actions to Advance a Carbon-Neutral Future

The OCAP includes the following objective for relying on green maritime shipping to advance a carbon-neutral future*:*

Objective: Advance the decarbonization of the U.S. Marine Transportation System (MTS), also referred to as "greening" maritime shipping and ports, as part of longer-term ambitions of economy wide net-zero GHG emission targets and zero GHG emissions from international shipping no later than 2050.[200] Accelerate research, development, and deployment of low- and zero-emission lifecycle fuels and technologies, revolutionize ship construction for engine and vessel technology supporting alternative and dual fuels, green U.S. ports, creation of green shipping corridors (maritime routes that showcase low- and zero emission lifecycle fuels and technologies with the ambition to achieve zero GHG emissions across all aspects of the corridor), and continue strong engagement with industry and international partners.

To meet this objective, the OCAP sets forth the following high-level actions in bold, which can be advanced through the additional efforts and strategies described in more detail below.

- **Advance U.S. commitment to the goal of zero emissions from international shipping no later than 2050** working with countries in the International Maritime Organization. Key Agencies: State/SPEC, DOE, DOT, MARAD, CMTS, USCG, EPA, NOAA
- **Accelerate maritime green shipping corridor development through research and development**
    - Identify existing maritime trade routes that could support green shipping corridors. Support the development of tools, including but not limited to: route trackers that identify existing and planned corridors; use existing interagency forums such as the CMTS and OPC to catalyze communication and visibility among stakeholders; and establish a curated library of green shipping corridor reports as part of the new Green Shipping Corridor Hub. (Key Agencies: DOT, DOE; Support: NOAA, DOI, CMTS, DOD, OPC, USCG; Timeframe: Mid-term (6 months to 1 year to initiate)
    - Accelerate efforts to improve efficiency of maritime transportation system using advances in vessel and port operations. (Key Agencies: DOE, MARAD; Timeline: Ongoing)
    - Accelerate efforts to incorporate environmental observations and data collection, analysis and modeling to improve efficiency of port and vessel operations (including vessel routing). (Key Agencies: DOE, MARAD, NOAA; Timeline: Ongoing)
    - Through the Great Lakes/Saint Lawrence Seaway System Green Shipping Corridor Network Initiative, host consultations with ports and other stakeholders with the goal of facilitating the establishment of Great Lakes Green Shipping Corridor Network, building on work established by the "Joint Statement by the U.S. Department of Transportation

[200] The White House, President Biden's Leaders' Summit on Climate https://www.whitehouse.gov/briefing-room/statements-releases/2021/04/23/fact-sheet-president-bidens-leaders-summit-on-climate/. Last accessed March 2023.

and Transport Canada on the Nexus between Transportation and Climate Change,"[201] and by working with State, local, private-sector, and non-governmental leaders, Tribal Nations, and Indigenous Peoples. (Key Agencies: State/SPEC, DOT; Timeframe: Ongoing).

- Foster country partnerships to help facilitate green shipping corridors in coordination with ports and other stakeholders, including through the Green Shipping Challenge. Implement existing green shipping corridor projects involving country partnerships, including projects with the United Kingdom, Republic of Korea, Canada (mentioned above), Panama, and Fiji. (Key Agencies: State/SPEC, DOT; Timeframe: Immediate)
- Facilitate interagency partnerships to help advance domestic green shipping corridors through existing U.S. Federal-maritime stakeholder forums, such as National Harbor Safety Advisory Committees and relevant Federal advisory committees. (Key Agencies: CMTS, USCG, MARAD, EPA, State/SPEC; Timeframe: Immediate)
- Develop a cross-agency program to invest in U.S. technology and manufacturing to spur development of US innovation address R&D hurdles for maritime applications to enable rapid development of technologies for commercial applications to meet decarbonization goals (Key Agencies: MARAD, DOE; Support: USCG; Timeframe: 2-5 years to initiate)
- Assess the current U.S. technology and manufacturing capabilities to address R&D and grow these applications; and recommend how Federal financing and expertise can expedite their development (Key Agencies: DOE, USCG, MARAD, EPA; Support: CMTS, NOAA, NSF; Timeframe: Initiate within 6 months)
- Undertake feasibility studies to understand opportunities and options for implementing low- and zero-emission fuels and technologies for port and maritime operations in the United States and with international partners. including through the Green Shipping Corridors Initiation Project. (Key Agencies: DOE, State/SPEC, MARAD, DOT; Support: USACE, MARAD, DOT; Timeframe: Mid-term (6 months-2 years) to initiate)
- Assess existing Federal funding mechanisms towards co-locating low- and zero-emission fuel hubs with port facilities and terminals along green shipping corridors and recommend appropriate policies or practices that will advance these goals. (Key Agencies: DOE, USCG, MARAD; Support: NOAA, DOI, NSF, State/SPEC; Timeframe: Immediate (0-6 months) to initiate)
- Promote existing Federal capacities and combine coastal observations, modeling, predictions, projections, products, and services into an interoperable framework. (Key Agency: NOAA; Timeframe: Mid-term (12-18 months) to complete)
- De-risk adoption and availability of alternative fuels and technologies for U.S. vessel owners and operators. (Key Agencies: MARAD, DOE; Support: USCG; Timeframe: 0-6 months to initiate)
- Incentivize and enable the shipping industry to adopt zero-emission fuels and technologies by establishing a dedicated funding program for U.S. vessel owner and operators to adopt greener technology (Key Agencies: MARAD, DOE, EPA, USCG; Timeframe: Initiate in 0-6 months)

- **Green the Nation's ports by upgrading, modernizing, and decarbonizing port infrastructure and operations**

[201] U.S. Department of Transportation. Joint Statement by the U.S. Department of Transportation and Transport Canada on the Nexus between Transportation and Climate Change. (February 25, 2021). https://www.transportation.gov/briefing-room/joint-statement-us-department-transportation-and-transport-canada-nexus-between. Last accessed March 2023.

- Provide incentives to upgrade, modernize, and decarbonize U.S. ports. Prioritize resources to benefit small businesses and environmental justice communities. (Key Agencies: EPA, MARAD, DOE, USACE; Support: USCG; Timeframe: Immediate (0-6 months to initiate))
    - Include transportation electrification in existing grants, as appropriate, to ground support equipment at ports. (Key Agencies: DOE, MARAD, EPA; Timeframe: Initiate within 6 months)
    - Expand real-time data collection, analytics, and communication to enable more efficient and resilient port operations in an effort to enhance the reduction of shoreside and vessel GHG emissions (Key Agencies: MARAD, NOAA; Timeline: Ongoing)
- Through interagency expertise and stakeholder outreach, assess the value of infrastructure projects, management regimes, and partnerships, that increase the resilience, including through the use of nature-based solutions, of the maritime transportation system (MTS) to impacts of climate change such as sea-level rise, flooding, and extreme weather events. (Leads: CMTS Maritime Resilience Integrated Action Team; Timeframe: Initiate within 6 months))

- **Incentivize and enable the shipping industry to adopt zero-emission fuels and technologies**
    - Develop recommendations on how to better support greater R&D efforts in the U.S. to research, develop, and demonstrate low and zero emission fuels and technologies. (Key Agencies: DOE, MARAD, CMTS, EPA; Support: DOD; State/SPEC; Timeframe: Initiate within 6 months)
    - Continue initiatives within the International Maritime Organization to adopt a revised Strategy on reduction of GHG emissions from ships with the goal to phase out GHG emissions from international shipping to zero emission by no later than 2050. (Key Agencies: State/SPEC, USCG Support: DOE, EPA, MARAD, DOT, NOAA; Timeframe: Immediate)
        - Support ongoing technical efforts to develop rigorous international guidelines for lifecycle assessments of marine fuels, enabling the implementation of measures to transition the shipping sector to low- and zero-emission fuels. (Key Agencies: State/SPEC, USCG, Support: MARAD, EPA, DOT, DOE; Timeframe: Immediate)
    - Develop and implement a U.S. Maritime Decarbonization Strategy flowing from the U.S. National Blueprint for Transportation Decarbonization released by DOT, EPA, DOE and HUD. (Key Agencies: DOE, EPA, MARAD; Support: CMTS, CEQ, State/Spec; Timeframe: Mid-term (6 months – 1 year) to complete)
    - Accelerate the adoption of low- and zero-emission fuels and increase their operational availability through multiple pathways including:
        - Support maritime green fuel and energy hubs including green hydrogen (Key Agencies: DOE, DOT; Support: DOI/BOEM, DOT; Timeframe: Initiate within 6 months)
        - Developing public-private partnerships to develop green hydrogen production and distribution facilities for refueling green hydrogen, methanol, and/or green

ammonia vessels (Key Agencies: DOE, DOT; Support: NOAA; Timeframe: Initiate within 6 months)
    - Identify opportunities within existing Federal grants for installation of low- and zero-emission fuel infrastructure at U.S. ports (Key Agencies: DOE, MARAD, EPA; Timeframe: Initiate within 6 months)
  - Consider and develop a robust national data collection system to collect fuel consumption and emission reporting for commercial vessels using U.S. ports. (Key Agencies: USCG, EPA; Timeframe: Mid-Term (6 months-2 years) to complete)
  - Promote vessel energy efficiency applications for near term GHG emissions reductions. (Key Agencies: MARAD, DOE; Timeframe: Mid-term (6 months-1 year) to initiate)
  - Implement the ban on heavy fuel use by commercial ships in the Arctic, and consider opportunities to advance work to reduce or eliminate emissions of black carbon impacting the Arctic. (Key Agencies: USCG, EPA, State/SPEC; Support: MARAD. Timeframe: Mid-Term (6 months-2 years) to complete)
  - Promote greater diverse, STEM-focused maritime workforce development for the rapid and just transition and operation of zero-emissions vessel and port equipment (as developed) and coordinate training for advanced technology systems as the industry starts to implement such technologies on a wide scale throughout the maritime sector. (Key Agencies: DOE, MARAD; Support: USCG, EPA, MARAD, NSF; Timeframe: Immediate (1–2 years to initiate or as technology evolves). Advance synergies between offshore renewables development and maritime decarbonization, such as through the construction and deployment of U.S. manufactured and crewed zero-emission offshore wind support vessels.[202] (Key Agencies: DOE, MARAD, USCG; Timeframe: Initiate within 6 months)
  - *Shared Action (Offshore Wind and Other Marine Energy):* Investigate the requirements of and make recommendations for offshore wind production and storage of green hydrogen to electrify various sectors of the MTS. (Key Agencies: DOI/BOEM, DOE; Support: USCG, MARAD, NOAA; Timeframe: Long-term (2-5 years) to initiate)

- **Revolutionize ship construction to build zero-emission U.S.-flag commercial fleet**
  - Fund a grand challenge to design and build or convert a fleet of U.S.-flag commercial vessels capable of operating with a low- and zero- greenhouse gas emissions footprint. Explore methods to reduce or eliminate GHG emissions during vessel construction (Key Agencies: MARAD, DOE; Support: EPA, DOD; Timeframe: Long-term (10–30 years to complete)
  - Accelerate the transition to a zero-emission U.S. Federal fleet by requiring any non-military ships constructed using Federal funds to be operated by low- and zero-lifecycle emission fuels (Key Agencies: NSF, NOAA, USCG, USACE, MARAD, CBP; Support: DOD, EPA; Timeframe: Long-term (5 – 10 years to implement)
  - Support the incorporation of ship technologies into new vessel design that reduce air emissions, including GHGs. Emphasize technologies with environmental co-benefits such as underwater noise reduction. (Key Agencies: DOD, MARAD; Support: State/SPEC, USCG, MMC; Timeframe: Long-Term (2-5 years) to complete)

[202] Green Shipping Challenge. https://greenshippingchallenge.org/. Last accessed March 2023.

- *Shared Action (Climate-Ready Fisheries and Fishing Communities):* Conduct scoping to understand the requirements associated with electrification of U.S. domestic vessels, including shore-side infrastructure, and explore the potential expansion of existing (or the creation of new) funding programs to support this transition for fishing and other domestic vessels. Key Agencies: DOE, DOT, NOAA; Timeframe: Mid-Term (6 months to 1 year) to initiate)

Sequestration of CO_2 in Sub-seabed Geologic Formations to Advance a Carbon-Neutral Future

The OCAP includes the following objective for the sequestration of CO_2 to advance a carbon-neutral future*:*

Objective: Advance the knowledge base and capacity for sequestration of captured CO_2 in sub-seabed geologic formations as one avenue to reduce net CO_2 emissions and contribute in a meaningful way to U.S. climate mitigation commitments. Scientific and socioeconomic information is needed to develop a regulatory framework based on Congressionally-mandated requirements for sub-seabed sequestration of CO_2 that will ensure safe, long-term carbon storage and protect human health, the marine environment, and potentially affected communities, particularly those that are historically overburdened. Continually improved knowledge about the efficacy, costs, tradeoffs, and human and environmental impacts of sub-seabed sequestration will help guide management decisions.

To meet this objective, the OCAP sets forth the following high-level actions in bold, which can be advanced through the additional efforts and strategies described in more detail below.

- **Develop a marine geologic sequestration program for the U.S. Outer Continental Shelf**
    - Engage in robust outreach to government partners, Tribal nations, local communities, ocean users, and key stakeholders to inform the development of an offshore carbon sequestration program for the U.S. Outer Continental Shelf. (Key Agencies: DOI/BOEM, DOI/BSEE; Support: DOE; Timeframe: Ongoing)
    - Promulgate a joint DOI rule implementing authority from BIL to grant a lease, easement, or right-of-way on the Outer Continental Shelf for activities that provide for, support, or are directly related to the injection of a carbon dioxide stream into sub-seabed geologic formations for the purpose of long-term carbon sequestration. (Key Agencies: DOI/BOEM, DOI/BSEE; Support: NOAA. Timeframe: Proposed rule in CY 23)

- **Assess opportunities to harmonize regulatory frameworks for sub-seabed CO_2 sequestration in geologic formations across the marine space**
    - Clarify relationships between domestic regulatory regimes, as well as the domestic and international governance frameworks for sub-seabed CO_2 sequestration, including:
        - domestic regulations under OCSLA; the Marine Protection, Research, and Sanctuaries Act (MPRSA); and the Safe Drinking Water Act (SDWA). (Key Agencies: DOI/BOEM, DOI/BSEE on the OCS; EPA in ocean waters other than on the OCS; Support: DOE. Timeframe: Ongoing)
        - the international governance framework under the London Convention and London Protocol (The United States is a party to the London Convention and has signed but not ratified the London Protocol. The United States implements international obligations under these treaties primarily through the MPRSA). (Key Agencies: State/SPEC, EPA, DOI; Timeframe: Ongoing)
    - Coordinate onshore and offshore geologic sequestration efforts. (Key Agencies: EPA, DOI/BOEM, DOI/BSEE; Timeframe: Ongoing)

- Ensure smooth interagency and intergovernmental coordination, including through inclusive engagement with frontline communities and affected stakeholders, on offshore sub-seabed CO_2 sequestration siting, projects, and regulation to maximize climate benefits and minimize human and environmental risk. (Key Agencies: DOI/BOEM, DOI/BSEE, EPA; Support: DOE, DOT/PHMSA, NOAA, USCG, IRS, DOI/USGS; Timeframe: Ongoing)
- Consider capacity needs for regulatory agencies to address permitting and regulation of sub-seabed CO_2 sequestration. (Key Agencies: DOI/BOEM, DOI/BSEE, EPA; Support: DOE; Timeframe: Ongoing)

- **Advance research, monitoring, and development on sub-seabed CO_2 sequestration**
  - Conduct R&D on injection pilot to full-scale demonstration projects for off-shore sequestration, including investigation of different geologic reservoirs, CO_2 transportation options, environmental monitoring, and tracking and modeling of CO_2 release during injection and leakage. This action is being facilitated by the inclusion of offshore geological carbon sequestration projects within the Carbon Storage Assurance Facility Enterprise (CarbonSAFE) Initiative being funded through BIL section 40305 - Carbon Storage Validation and Testing. (Key Agencies: DOE; Support: DOI/BOEM/BSEE, EPA; Timeframe: Implementing from 2023-2030)
  - Leverage FECM investments in sub-seabed CO_2 sequestration (offshore CCS) efforts to develop site screening and decision-support tools for stakeholders and regulators (Key Agency: DOE; Support: DOI/BOEM, DOI/BSEE, EPA, DOI/USGS; Timeframe: Implementing from 2024-2030)
  - Utilize *in situ* and remote sensing assets to evaluate and monitor effectiveness of sequestration approaches (Key Agencies: NASA, DOE, NOAA, DOI/BOEM, DOI/BSEE, EPA; Timeframe: 6-18 months to initiate)

Marine Carbon Dioxide Removal Actions to Advance a Carbon-Neutral Future

The OCAP includes the following objective for marine carbon dioxide removal to advance a carbon-neutral future*:*

Objective: By 2030, build sufficient knowledge about the efficacy and tradeoffs of different methods of marine carbon dioxide removal (CDR) and use it to guide deployment decisions. This knowledge base is needed to determine if and how various proposed techniques are viable options for the United States to reduce net CO_2 emissions and contribute in a meaningful way to U.S. climate mitigation commitments. Develop a robust regulatory framework for research and possible later deployment to protect human health, the marine environment, and potentially affected communities, and ensure safe long-term carbon storage.

To meet this objective, the OCAP sets forth the following high-level actions in bold, which can be advanced through the additional efforts and strategies described in more detail below.

- **Set policy and regulatory standards for marine CDR research and implementation**
    - Clarify the existing domestic and international regulatory framework for marine CDR research and implementation, including:
        - Domestic regulation under the Marine Protection, Research, and Sanctuaries Act (MPRSA), Clean Water Act (CWA), Rivers and Harbors Act (RHA) (Key Agencies: EPA, USACE; Support: NOAA; Timeframe: Mid-term (6 months-2 years) to initiate)
        - International regulation under the London Convention and London Protocol (The United States is a party to the London Convention and has signed but not ratified the London Protocol. The United States implements international obligations under these treaties primarily through the MPRSA). (Key Agencies: State/SPEC, EPA; Support: USACE, NOAA; Timeframe: Ongoing)
    - Establish guidelines for transparent measuring, monitoring, reporting, and verification (MMRV) to support permit development for marine CDR activities (Key Agencies: EPA, USACE, DOE; Support: NOAA; Timeframe: Mid-term (6 months-2 years) to initiate)
    - Evaluate capacity needed for regulatory agencies to address permitting and regulation of marine CDR field research and large-scale deployment (Key Agencies: EPA, USACE; Support: NOAA; Timeframe: Mid-term (6 months-2 years) to initiate)
    - Increase interagency coordination on marine CDR research, development, and regulation (Key Agencies: DOE, EPA, USACE, NOAA; Support: DOI/USGS, DOD/DON, NSF; Timeframe: Mid-term (6 months-2 years) to initiate)
    - Engage in robust outreach to government partners, Tribal Nations, communities, ocean users, and key stakeholders to inform the development of a marine CDR research program. (Key Agencies: NOAA, DOE, EPA, USACE; Support: DOD/DON; Timeframe: Ongoing)
- **Implement a comprehensive Federal research and scaled testing program for promising marine CDR approaches, including marine energy sources**
    - Design marine CDR research program considering recommendations from the 2022 NASEM ocean-based CDR report and similar science community reports (e.g., GESAMP

Working Group 41) [203] (Key Agencies: NOAA, DOE; Support: NSF, NASA, EPA; Timeframe: Immediate (0-12 months) to initiate)

- Accelerate natural science and engineering research on marine CDR, across theory, laboratory, field, and modeling studies, to determine the climate mitigation potential of different CDR approaches, with a focus on efficacy of atmospheric CO_2 removal, permanence of carbon storage, scalability, energy and resource demands, and costs without adverse impacts on the marine environment, human health, and other uses of the sea (Key Agencies: DOE, NOAA; Support: NSF, NASA, DOI, DOD/DON, EPA; Timeframe: Mid-term (6 months-2 years) to initiate)
- Ensure that research and scale-up of marine CDR technologies adhere to appropriate regulatory frameworks to ensure the protection of human health and the environment. (Key Agencies: EPA, USACE; Timeframe: Mid-term (6 months-2 years) to initiate)
- Partner with academia, industry, philanthropy, other governmental, and non-governmental organizations through interagency vehicles such as NOPP to accelerate scale and speed of marine CDR research progress (Key Agencies: NOAA, DOE, EPA, USACE; Support: DOI/USGS/BOEM, DOD/DON, NASA; NSF Timeframe: Mid-term (6 months-2 years) to initiate)
- Leverage ongoing international efforts, such as the UN Decade of Ocean Science for Sustainable Development, to contribute, co-develop and upscale marine CDR approaches. (Key Agencies: NOAA, DOE; Support: NSF, NASA, EPA, State/SPEC; Timeframe: Immediate (0-12 months) to initiate)
- *Shared action (Offshore Wind and Other Marine Renewable Energy):* Assess additional potential uses of marine energy sites, including to power in-situ ocean and atmosphere observing platforms and mCDR technologies. (Key Agencies: DOE, DOI/BOEM, NOAA, EPA, USACE; Support: USCG, DOD/DON; Timeframe: Mid-term (6 months-2 years) to initiate)

- **Launch a U.S. Marine CDR Initiative** to serve as a coordination vehicle for public-private funded research activities and to facilitate the creation of new marine CDR demonstration sites with the goal of delineating marine CDR benefits, risks, and challenges. Key Agencies: SOST Co-chairs, NOAA, NSF, EPA; Support: DOE, NASA, NOPP, DOI/BOEM/BSEE. Timeframe: Immediate (0-6 months to initiate).

- **Ensure robust, sustained, and adequate ocean observations (*in situ*, remote sensing) are in place**
  - Continue and expand support of ocean observing assets (*in situ* and remote sensing) that will enable assessments of ecosystem health before, during, and after CDR activities and for testing and refining ocean climate models that will inform further marine CDR efforts. Key Agencies: NASA, NOAA, NSF; Timeframe: Immediate)

- **Develop standards for carbon accounting for marine CDR approaches**

[203] GESAMP (2019). High level review of a wide range of proposed marine geoengineering techniques. (Boyd, P.W. and Vivian, C.M.G., eds.). (IMO/FAO/UNESCO-IOC/UNIDO/WMO/IAEA/UN/UN Environment/ UNDP/ISA Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection). Rep. Stud. GESAMP No. 98. http://www.gesamp.org/publications/high-level-review-of-a-wide-range-of-proposed-marine-geoengineering-techniques.

- Evaluate metrics on atmospheric CO_2 removal scale, carbon storage duration, and emissions of other GHGs and climate impacts for marine CDR contributions to U.S. climate mitigation goals (Key Agencies: NOAA, DOE, DOI, EPA; Support: DOI/USGS; NSF. Timeframe: Mid-term (6 months-2 years) to initiate)
- Create and implement pilot programs to develop standard validation protocols and carbon accounting systems for marine CDR approaches (Key Agencies: NOAA, DOE, EPA, NASA; Support: DOI/USGS; Timeframe: Mid-term (6 months-2 years) to initiate)
- Expand capabilities for marine CDR measuring, monitoring, reporting, and verification (MMRV), through development of next-generation technology, infrastructure, modeling, and data science for biogeochemical ocean and marine atmosphere observing assets and systems (Key Agencies: NOAA, DOE, EPA, NASA; Timeframe: Mid-term (6 months-2 years) to initiate)

- **Evaluate the environmental and social impacts of marine CDR approaches**
  - Expand social science research on the effects of marine CDR approaches on people and communities, and incorporate the assessment of environmental and social impacts as an integral component of marine CDR research and implementation projects (Key Agency: NOAA; Support: NSF, EPA, DOE; Timeframe: Mid-term (6 months – 2 years to initiate)
  - Explore potential of marine CDR approaches for mitigating ocean acidification and other possible co-benefits at local to regional scales (Key Agencies: NOAA, EPA; Support: DOE; Timeframe: Mid-term (6 months-2 years) to initiate)
  - *Shared action (OCAP Priority— Support Ocean Research, Observations, Modeling, Forecasting and Synthesis):* Consider opportunities to co-locate CDR research activities at common ocean test-bed sites to facilitate effective permitting, environmental impact assessment, and measuring, monitoring, reporting, and verification (MMRV) of marine CDR technologies in conjunction with research and testing on other ocean solutions (Key Agencies: EPA, NOAA, DOE; Support: NSF; Timeframe: Mid-term (6 months-2 years) to initiate)

- **Incorporate environmental justice and equity in marine CDR research and implementation**
  - Support and implement a U.S. community-developed code of conduct for marine CDR research and development to ensure marine CDR research is conducted responsibly and ethically. (Key Agencies: NOAA, EPA, DOE; Support: NSF, NASA; Timeframe: Initiate within 6 months)
  - Engage the public, especially disadvantaged and Indigenous communities, in the design and implementation of marine CDR research to minimize impacts and inequities on local populations (Key Agencies: DOE, NOAA, EPA; Timeframe: Initiate within 6 months)
  - Engage with global partners, including through the London Convention and London Protocol, to ensure marine CDR research and implementation aligns with sustainable development and climate justice goals (Key Agencies: State/SPEC, EPA, USACE; Support: NOAA; Mid-term (6 months-2 years) to initiate)

OCAP Priority—Address Ocean Acidification

- **Accelerate research and monitoring on ocean acidification** (Key Agencies: NOAA, NASA, EPA)

- **Expand engagement with U.S. coastal communities vulnerable to ocean acidification, especially tribal communities** (Key Agencies: NOAA, EPA; Timeframe: Ongoing)
    - Equip communities with ability to monitor and assess vulnerability to OA through technical assistance.
    - Expand social science research.

- **Create a U.S. Ocean Acidification Action Plan** (Key Agencies: State/SPEC, NOAA, IWG-OA; Timeframe: complete by Fall, 2023)
    - Identify and promote U.S. actions that address the root causes of ocean acidification (carbon emissions reduction and nutrient run off)
    - Highlight U.S. leadership and priorities
    - Highlight the coordinated approach the U.S. has taken to study and address ocean and coastal acidification across Federal, State/SPEC, Tribal, and local levels
    - Identify scientific gaps and opportunities for further action, including ocean acidification reduction through marine CDR and control of nutrient pollution
    - Promote and lead even greater international collaboration between members of the Ocean Acidification Alliance, including other interested countries.

- **Continue to raise awareness about ocean acidification as a significant problem for marine life and a sustainable ocean economy and bolster international efforts to address the problem.** Key Agencies/Offices: NOAA, State/SPEC, EPA. DOE. NSC, OSTP
    - Strengthen US and international support for the Global Ocean Acidification Observing Network, the OA-International Coordination Centre, the Alliance to Combat Ocean Acidification, the OA Information Exchange and other regional/international efforts as they arise
    - Bring ocean acidification reduction more robustly into rationale for renewable energy

- **Ensure that ocean acidification and its impacts are included in discussions of potential solar geoengineering and carbon dioxide removal approaches.** Key Agencies/Offices: NOAA, State/SPEC, DOE, NSC, OSTP, EPA
    - Make connections between CDR and its potential for OA mitigation on local scales.
    - Conversely, highlight how some geoengineering methods, such as solar radiation management, will not slow down ocean acidification.

Blue Carbon Actions as Nature-Based Solutions

The OCAP includes the following objective for Blue Carbon Actions as Nature-Based Solutions to climate mitigation and adaptation*:*

Objective: Advance the protection, conservation, restoration, and sustainable management of coastal and marine habitats that naturally store carbon ("blue carbon") as a key element of U.S. land and ocean conservation and climate mitigation goals through nature-based solutions[204]. Include the protection, conservation, and restoration of blue carbon habitats, which also provide social, environmental and biodiversity benefits, as a priority in coastal resource planning and management decisions. Quantify potential for blue carbon contributions to climate mitigation targets.

To meet this objective, the OCAP sets forth the following high-level actions in bold, which can be advanced through the additional efforts and strategies described in more detail below.

- **Retain coastal blue carbon and carbon sequestration and storage as a priority in the America the Beautiful initiative to conserve at least 30 percent of U.S. lands and waters by 2030**
    - Identify options to accelerate progress and priorities for coastal restoration with the greatest potential for climate and coastal benefit as well as by incentivizing conservation, protection, restoration (including post-restoration monitoring), and sustainable management of coastal blue carbon ecosystems. (Key agencies: CEQ, DOI/USGS, NOAA, USDA. Timeframe: Ongoing.)

- **Support research and development initiatives in known blue carbon habitats**
    - Continue interagency efforts and coordination on blue carbon that supports scientists, community of practice groups, and policy makers so they have the information needed to advance blue carbon research collectively. (Key Agencies: NOAA, DOI/FWS; Support: DOI/USGS, EPA; Timeframe: Mid-term (6 months-2 years)
    - Expand research and observations on carbon cycle processes, including: quantifying and predicting coastal wetland carbon fluxes across different habitats, geographic regions, levels of ecosystem protection and restoration, and under varying conditions, including effects of sea level rise and human drivers such as impacts of land management actions, and effects of declining flora and fauna populations on all blue carbon ecosystems. (Key Agencies: NOAA, NASA, DOI/FWS and DOI/USGS; Support: EPA, NSF; Timeframe: Mid-term (6 months-2 years) to implement)
    - In partnership with the Smithsonian Institution, quantify and map current and potential blue carbon stores in a centralized data repository to help guide local communities and Tribal Nations, States, U.S. Territories, and Federal agencies and as they work to

[204] White House Council on Environmental Quality, White House Office of Science and Technology Policy, White House Domestic Climate Policy Office. (2022). Opportunities for Accelerating Nature-Based Solutions: A Roadmap for Climate Progress, Thriving Nature, Equity, and Prosperity. Report to the National Climate Task Force. https://www.whitehouse.gov/wp-content/uploads/2022/11/Nature-Based-Solutions-Roadmap.pdf.

manage coastal and marine ecosystems. (Key Agencies: NOAA, DOI/FWS and DOI/USGS; Timeframe: Mid-term (6 months-2 years) to complete)
    - Expand research projects that identify and estimate the extent of blue carbon ecosystems, identify the highest potential to avoid emissions and store carbon in coastal habitats, and quantify the climate-protective potential of priority organisms, such as macroalgae. (Key Agencies: NOAA, DOI/FWS and DOI/USGS, DOI/NPS, NASA; Timeframe: Long-term (2-5 years))
    - *Shared action (Marine CDR):* Conduct research on blue carbon biota, such as kelp and *Sargassum*, to determine potential carbon sequestration and other ecosystem services that can benefit communities. (Key Agencies: NOAA, DOI/FWS and DOI/USGS, NASA; Timeframe: Mid-term (6 months-2-5 years) to complete)
- **Conduct research, exploration, and mapping to determine blue carbon potential coastal and marine ecosystems**
    - Develop inventories for coastal and marine ecosystems, such as kelp and sargassum, vertically migrating fishes and zooplankton, marine mammals, and marine sediments; quantify impacts on carbon storage from mining, fishing, and trawling. (Key Agencies: DOE, NOAA; Support: NSF, NASA. Timeframe: Mid-term (6-12 months to initiate))
    - Work with national and international partners to build capacity for Blue Carbon Ecosystems and related greenhouse gas inventories for coastal and marine ecosystems to determine carbon sequestration rates and other ecosystem services that can benefit communities; resolve current unknowns about role of vertically migrating fishes and zooplankton, marine mammals, and fisheries in the ocean carbon cycle, and assess any long-term impacts on carbon storage from marine sediment disturbance (Key Agencies: State/SPEC, OSTP, NOAA; Support: DOI/USGS, DOI/FWS; NASA; Timeframe: Ongoing)

- **Develop standards for blue carbon management for different coastal and ocean habitats**
    - Support the community of practice that engages and empowers people, communities (particularly those that will strengthen environmental justice), NGOs, and governments to tackle these challenges and improve climate resilience and the health of our seas and the communities that rely on them. (Key Agencies: DOI/FWS, DOI/NPS; Support: NOAA; Timeframe: Mid-term (6 months-2 years) to complete)
    - Streamline and standardize 'blue carbon protocols'[205] and valuation metrics for nature-based solutions so that developers and landowners can more easily generate confirmable carbon credits in both state and national climate programs. (Key Agencies: DOI/FWS, NOAA; Support: DOE, EPA, DOI/USGS; Timeframe: Mid-term (6 months-2 years) to complete)
    - Develop tools to measure, monitor, account for and protect blue carbon ecosystems. (Key Agencies: DOI/FWS, NOAA, NASA; Support: DOE; Timeframe: Mid-term (6 months-2 years) to complete)
    - Develop and implement guidelines and a tracking system to assess the impacts of coastal habitat protection and restoration efforts on carbon sequestration and storage. (Key Agencies: NOAA, DOI/USGS; Support: DOI/FWS, DOD/USACE; Timeframe: Initiate within 6 months)

[205] Howard, J., Hoyt, S., Isensee, K., et al. (2014). Coastal Blue Carbon: Methods for assessing carbon stocks and emissions factors in mangroves, tidal salt marshes, and seagrass meadows. Conservation International, Intergovernmental Oceanographic Commission of UNESCO, International Union for Conservation of Nature. https://www.thebluecarboninitiative.org/manual.

- **Prioritize conservation, protection, and enhancement of existing coastal blue carbon wetland habitats, and restoration of degraded or potential blue carbon habitats**
    - Expand research into the effectiveness of restoration tactics to increase blue carbon potential. (Key Agencies: NOAA, DOI/FWS, DOI/USGS; Timeframe: Initiate within 6 months)
    - Develop a database of blue carbon conservation and restoration projects to inform design and implementation of future projects. (Key Agency: DOI/FWS; Support: NOAA, DOI/USGS; Timeframe: 2 years to complete).
    - Identify important wetland ecosystems for conservation. (Key Agency: DOI/FWS, EPA; Support: NOAA, DOI/NPS; Timeframe: Long-Term (2-5 years) to complete)
    - Provide technical assistance for conserving and enhancing coastal wetland ecosystems by: actively managing to prevent future losses in carbon capacity; reestablishing former wetlands; removing tidal restrictions; incorporating nature-based features and performance monitoring in coastal resilience projects; augmenting engineered projects with nature-based solutions; and promoting managed wetland migration in response to sea level rise. (Key Agencies: DOI/FWS, EPA; Support: NOAA, DOI/NPS, DOI/USGS, USACE, DOD/DON; Timeframe: Long-Term (2-5 years))

- **Conduct a regional to national research and monitoring program of post-restoration coastal blue carbon habitats** to address the current lack of high-quality monitoring in blue carbon studies before and after restoration interventions; leverage reserves like the National Estuarine Research Reserve System (NERRS) that provide an excellent opportunity to serve as valuable calibration points for remote sensing-based monitoring of coastal blue carbon baselines and change; by 2026, the study would include two reserves in each U.S. region (including in the Great Lakes) and include lateral fluxes of wetland surface water and carbon species to improve carbon budget calculation and sequestration estimates. (Key Agencies: NOAA, DOI/FWS; Support: DOI/USGS, NASA; Timeline: 0-6 months to initiate.)

Climate-Adaptive Marine Protected Areas Actions as Nature-Based Solutions

The OCAP includes the following objective for Climate-Adaptive Marine Protected Areas as Nature-Based Solutions to climate mitigation and adaptation*:*

Objective: Create, strengthen, connect, and expand climate-adaptive Marine Protected Areas (MPAs). Using science and research to ensure they are climate adaptive, well-managed MPAs serve both local and national needs and are an important tool for reducing and preventing further climate change stresses on marine environments. The ecosystem resilience imparted by high-levels of protection, adaptive management, and connected MPA networks results in climate adaptation benefits.

To meet this objective, the OCAP sets forth the following high-level actions in bold, which can be advanced through the additional efforts and strategies described in more detail below.

- **Create, connect, strengthen, and expand Marine Protected Areas (MPAs) and MPA networks, while enhancing the connectivity of MPAs with one another as well as onshore and inland conservation and use adaptive management**
    - Harness best practices, recommendations, and guidance from the National MPA Center and other resources for approaches to using MPAs as a tool for climate action as well as to improve their overall effectiveness. Support interagency collaboration to enhance MPA Center effectiveness and ensure it is continually informed by evolving scientific information and Indigenous Knowledge. (Key Agencies: NOAA, DOI/FWS, DOI/NPS; Timeframe: Within 6 months)
    - Mobilize countries to conserve or protect 30% of their jurisdictional ocean waters through endorsements of the Ocean Conservation Pledge. (Key Agency: State/SPEC; Timeframe: Short- to Mid-terms (0-36 months)
    - Work internationally to promote the global 30x30 goals, as agreed to at the Convention on Biological Diversity COP15. (Key Agency: State/SPEC; Timeframe: Ongoing)
    - Ensure that MPA management plans address current conditions and future climate effects through adaptive management, including opportunities to strengthen the level of protection within MPAs to enhance their resilience to climate change. (Key Agencies: NOAA, DOI/FWS, DOI/NPS; Timeframe: Mid-term (6 months-2 years)
    - Support new and more research as well as ongoing monitoring to better understand the relationships between climate-readiness and MPA size, level of protection, and enabling conditions. (Key Agencies: NOAA, DOI; Timeframe: Mid-term (6 months-2 years))
    - Foster ecologically-connected MPA networks that promote climate resilience and adaptation for species and habitats undergoing range shifts, including evaluating the effectiveness of MPAs to help recover depleted populations. (Key Agencies: NOAA, DOI; Timeframe: Mid-term (6 months-2 years)
    - Harness all available MPA tools, research and monitoring to support appropriate carbon mitigation, including blue carbon conservation, green operations, ocean industry partnerships, renewable energy, and public education. (Key Agencies: NOAA, DOI; Timeframe: Mid-term (6 months-2 years)

- *Shared Action (Climate-Ready Fisheries and Fishing Communities*): Implement the NOAA Climate, Ecosystems, and Fisheries Initiative (CEFI) to provide MPA planners and managers with robust information to prepare for and adapt to changing climate and ocean conditions. (Key Agency: NOAA; Timeframe: Mid-term (6 months-2 years)

- **Promote public engagement, Tribal Consultation, and use of Indigenous Knowledge to advance climate-resilient MPAs**
  - Convene stakeholders (industry, fisheries, conservationists, communities, and other entities) to share new scientific information, develop a shared vision, and identify roles, responsibilities, and opportunities for climate resilient MPAs and networks at local, national, and international levels (i.e., the Ross Sea MPA in Antarctica). (Key Agencies: NOAA, DOI; Timeframe: Initiate within 6 months)
  - Identify existing and new opportunities to enhance management abilities in local communities and increase community awareness and engagement in conservation activities (e.g., through Federal, State/SPEC, and private investments). (Key Agencies: NOAA, DOI; Timeframe: Within 6 months)
  - Promote partnerships with ocean users to engage them in MPA management and research, enhance understanding of benefits of MPAs, and support compliance and enforcement. (Key Agencies: NOAA, DOI; Timeframe: Mid-term (6 months-2 years)

- **Expand research and development of monitoring and predictive capabilities and for climate-responsive adaptive management**
  - Develop, augment, and improve new observing, monitoring, and modeling technologies, such as UAVs (e.g., drones), satellite and airborne sensors, low-cost monitoring buoys, high-frequency radar, and Artificial Intelligence (AI) to promote adaptive management through improved ability to understand changes and thresholds, as well as analyzing and detecting potential violations using data from sources such as Automatic Identification Systems (AIS) and Synthetic Aperture Radar. (Key Agencies: NOAA, DOI; Support: DOD/DON, DOE, NSF, NASA; Timeframe: Mid-term (6 months-2 years to initiate)
  - Explore a partnership to invest in developing and augmenting new acoustic observing, monitoring and modeling technology and data analysis infrastructure (Key Agencies: DOD/DON, NOAA; Timeframe: Ongoing)
  - Support research to evaluate effectiveness of MPAs to address climate resilience. This can include renewable energy, carbon cycling and sequestration, adaptive management, and climate-ready fisheries and other co-benefits. (Key Agencies: NOAA, DOI; Timeframe: Mid-term (6 months-2 years)
  - Mobilize scientific communities (particularly information technology and AI) to promote the use of climate and ocean data by local communities. (Key Agencies: NOAA, DOI; Support: DOE; Timeframe: Mid-term (6 months-2 years)
  - Develop technological and management options for dynamic measures as part of MPA networks that can protect threatened species and habitats quickly in light of changing climate conditions (e.g., short-term actions to protect whales with changing migration patterns due to climate). (Key Agencies: NOAA, DOI; Support: MMC; Timeframe: Mid-term (6 months-2 years)

- **Prioritize work with Indigenous, urban and nature-deprived, and underserved communities to meet local and national needs through existing and new MPAs and MPA networks**
    - Establish new partnerships with underserved, urban areas, nature-deprived and Tribal and Indigenous communities to meet local needs through nature-based solutions (e.g., multiple benefits of MPAs, to protect and restore, public access, climate mitigation, coastal storm protection), implementing equity strategies consistent with Justice 40 within the National Estuary Program, EPA Geographic Programs, National Estuarine Research Reserves, or other coastal watersheds. Recognize and build on the Joint Secretarial Order[206] on Stewardship of Federal Lands and Waters (DOI/Dept of Ag). Key Agencies: NOAA, DOI, EPA, DOE, DOD/DON; Timeframe: Mid-term (6 months-2 years)
    - Work with communities to identify and prioritize areas with high ecological, biodiversity, and carbon sequestration and storage value for additional conservation, with a focus on local needs and concerns. Provide technical assistance as needed. (Key Agencies: NOAA, DOI; Timeframe: Mid-term (6 months-2 years)

- **Maximize the benefits of ocean co-use, by planning and siting non-extractive and non-destructive activities in or near marine protected areas where appropriate**
    - Coordinate interagency discussion and planning on maximizing ocean co-use opportunities through the OPC Ocean Resource Management sub-committee. Key Agencies: NOAA, DOI/BOEM, OPC/ORM. Timeframe: Ongoing.

- **Strengthen co-stewardship of lands and waters with Tribal Nations and Indigenous Peoples. (**Key Agencies: NOAA, DOI; Timeframe: Ongoing)
    - Building on experience and relationships with Tribal Nations and Indigenous Peoples, Federal agencies will continue to co-develop research programs and work towards co-stewardship of protected areas.
    - Consider, include, and apply Indigenous Knowledge and develop adaptation actions to address increasing climate impacts Tribal Nations and other Indigenous Peoples are facing to their homelands.
    - Update Federal agency Tribal consultation policies and develop new guidance on how to apply Indigenous Knowledge to Federal decision-making if they have not completed such updates already.
    - Strengthen relationships with Tribal Nations and other Indigenous Peoples through activities such as co-development of research programs, co-stewardship of protected areas (e.g., National Marine Sanctuaries), and joint development of management plans that articulate values and principles that align with Native American, Alaska Native, Native Hawaiian, and Indigenous culture and values, as well as the various Federal and State agency mandates and missions (e.g., as done for Mai Ka Pō Mai, a plan for Papahānaumokuākea Marine National Monument).

[206] DOI, Joint Secretarial Order on Fulfilling the Trust Responsibility to Indian Tribes in the Stewardship of Federal Lands and Waters (November 15 2021). https://www.doi.gov/sites/doi.gov/files/elips/documents/so-3403-joint-secretarial-order-on-fulfilling-the-trust-responsibility-to-indian-tribes-in-the-stewardship-of-federal-lands-and-waters.pdf.

Climate-Ready Fisheries, Protected Resources, Aquaculture and Fishing Communities Actions to Enhance Resilient Communities

The OCAP includes the following objective for Climate-Ready Fisheries, Protected Resources, Aquaculture, and Fishing Communities to Bolster Resilient Communities*:*

Objective: Advance and implement climate-ready management of fisheries and aquaculture and increase the resilience of fishing and coastal communities.

To meet this objective, the OCAP sets forth the following high-level actions in bold, which can be advanced through the additional efforts and strategies described in more detail below.

- **Provide marine resource decision makers and other ocean users with the information they need to assess risks and take action to adapt to changing ocean conditions**
    - Implement the NOAA Climate, Ecosystems, and Fisheries Initiative (CEFI) decision-support system to provide fisheries managers and communities (and other ocean users) with the actionable information they need to assess risks and take action to successfully adapt to rapidly changing ocean conditions. (Key Agency: NOAA; Support: DOI/USGS; Timeframe: Initiate within 6 months)

- **Enable Regional Fishery Management Councils and other bodies with Federal nexus to incorporate climate-ready approaches and decision-making**
    - NOAA will support the Regional Fishery Management Councils and Interstate Commissions where the USG has a role, in developing fishery management plan amendments and/or other measures to address climate change impacts, establishing management regimes that can be more responsive and resilient to future changes, and/or supporting climate-related planning and implementation efforts for underserved communities. (Key Agency: NOAA; Timeframe: Initiate within 1 year)
    - Establish clear goals, targets, and guidance for how Regional Fishery Management Councils (Councils) should consider climate resilience of fish stocks in management measures implemented under the Magnuson Stevens Fishery Conservation and Management Act (MSA). Timeframe: Mid-Term (6 months to 2 years).
    - Identify and support ways to operationalize climate-ready approaches in fisheries management, including the equitable transition to more flexible fishing portfolios and the implementation of a dynamic management system that can effectively respond to near-term extreme events and long-term changes. (Key Agency: NOAA working with the Fisheries Management Councils; Timeframe: Initiate within 6 months)
    - Enable and support continued transition to ecosystem-based fisheries management to more efficiently and effectively maintain healthy, productive, and resilient marine ecosystems in the face of a rapidly changing ocean. (Key Agency: NOAA. Timeframe: Ongoing.)
    - Implement proactive identification and adaptive management of bycatch to respond to shifting distributions of species and fishing, including changing interactions between fisheries and protected species (Key Agencies: NOAA, Marine Mammal Commission (MMC), DOI/FWS; Timeframe: Mid-Term (6 months – 1 year) to initiate).

- Develop a process for adjusting governance of fishing stocks that expand across multiple Fishery Management Council boundaries to ensure coordinated and sustainable management. (Key Agency: NOAA; Timeframe: Initiate within 1 year).
- Convene a workshop on alternate approaches to managing fisheries in a climate-changed world where monitoring and decision systems recognize the limits on predictability, anticipate surprises, and prepare accordingly; bring cutting-edge thinking to bear on innovative ways to re-think fishery management in light of climate change. (Key Agency: NOAA; Initiate within 1 year).

- **Co-produce and deliver the products, tools and assistance to support climate-ready fishing communities**
  - Co-produce and deliver the products, tools and assistance fishing communities need to assess risks and take action to increase resilience and adapt to rapidly changing ocean conditions, with a focus on supporting highly vulnerable and underserved communities, including Tribal and Indigenous Peoples for whom fisheries resources are essential sources of food, livelihood and cultural heritage. (Key Agency: NOAA; Support: DOI/USGS and BIA, USACE; Timeframe: Immediate to become regular practice)

- **Advance research, technologies, and observation systems to support climate-ready fisheries**
  - Accelerate the development and use of advanced technologies to modernize and expand ocean observation systems that provide fisheries and fishing communities with better information on what's changing, what's coming, and how to respond to changing ocean conditions. (Key Agencies: NOAA, NSF; Support: DOI, NASA; Timeframe: Immediate to become regular practice)
  - Expand regional monitoring of the distribution, phenology, and productivity of living marine resources to better track changes and inform climate-ready decision-making for fisheries, fishing communities, protected resources, and other ocean uses (e.g., wind energy siting). (Key Agency: NOAA; Support: NSF, DOI/BOEM, DOI/USGS; Timeframe: Immediate to initiate)
  - Increase research on current and projected future impacts of climate change on marine ecosystems including fisheries, protected species, and habitats. (Key Agency: NOAA; Support: DOI, NASA, NSF; Timeframe: Immediate to initiate)
  - Expand and sustain coastal, ocean and marine life observations, observation networks, and data formatting/data sharing efforts that ensure curated data are available for climate projections and habitat suitability, species distribution and ecosystem models and to support multi-species, ecosystem-based assessment, management, and conservation. (Key Agencies: NOAA, NASA, NSF; Support: DOI, DOI/USGS; Timeframe: Immediate and ongoing)
  - *Shared goal (MPAs):* Expand research to better understand the best practices and benefits of protecting and restoring ocean and coastal habitats to support resilient fisheries, and fishing communities in the face of rapidly changing ocean and coastal ecosystems (Key Agencies: NOAA, DOI/USGS; Support: DOI/FWS, USACE; Timeframe: Initiate within 6 months)

- **Expand and decarbonize sustainable U.S. aquaculture production to enhance resilience of U.S. and global seafood system to the impacts of climate change**
    - Enable and support expansion of climate-ready aquaculture operations using the best available information on current and future ocean and coastal ecosystem conditions to inform science-based planning for Aquaculture Opportunity Areas. (Key Agency: NOAA; Support: EPA, USACE; Timeframe: Initiate within 6 months)
    - Support research, development, and application of sustainable aquaculture to help meet Administration climate change goals, including climate change mitigation (e.g., blue carbon sequestration) and climate change adaptation (resilient fisheries, aquaculture, and fishing communities). (Key Agency: NOAA; Support: USDA; Timeframe: Initiate within 6 months).
    - Improve access to resources that will recognize and scale up seafood farming projects including Indigenous communities, Tribal Nations, and community-based organizations to increase access to climate-smart agriculture for food production and build climate resilience. (Key Agency: NOAA; Support: USDA, USACE; Timeframe: Initiate 6 months to 1 year).
    - Reduce costs and timeframes for siting and permitting for new and existing commercial-scale aquaculture operations, through investments in Aquaculture Opportunity Areas and other key areas that support sustainable growth of the industry and inform effective management decisions. (Key Agencies: NOAA, USACE; Support: DOD, EPA, USCG, DOI/FWS; Timeframe: Initiate within 6 months).

- **Identify, protect, and restore ocean and coastal habitats essential to climate-ready fisheries, protected species, and fishing communities**
    - Significantly increase protection and restoration of ocean and coastal habitats to increase resilience and adaptation of fisheries and fisheries communities to a changing climate and ocean. (Key Agencies: NOAA, DOI/USGS, DOD/USACE; Support: DOI/FWS, DOT; Timeframe: Initiate within 6 months)
    - Expand research to better understand the best practices and benefits of protecting and restoring ocean and coastal habitats to support resilient fisheries, and fishing communities in the face of rapidly changing ocean and coastal ecosystems (Key Agencies: NOAA, DOI/USGS; Support: DOI/FWS, USACE; Timeframe: Initiate within 6 months)

- **Explore research and development to transition to a climate-ready fishing fleet**
    - *Shared Action (Climate-Ready Fisheries and Fishing Communities):* Conduct scoping to understand the requirements associated with electrification of U.S. domestic vessels, including shore-side infrastructure, and explore the potential expansion of existing (or the creation of new) funding programs to support this transition for fishing and other domestic vessels. Key Agencies: DOE, DOT, NOAA; Timeframe: Mid-Term (6 months to 1 year) to initiate)
    - Advance next-generation technologies, including ropeless fishing technology investment, through public-private partnerships. (Key Agency: NOAA; Support: MMC, DOE, NSF; Timeframe: Initiate within 6 months)

- **As a tool for climate resilience, expand research that evaluates and advances the use and effectiveness of obsolete infrastructure to develop and enhance artificial reefs** used for commercial and recreational fishing and recreational diving.
    - Evaluate the potential climate resilience benefits and the potential ecological value of converting wind energy facilities as a substrate for artificial reefing and identify opportunities to advance the use of obsolete oil and gas structural material for marine and coastal benefit. (Key Agency: DOI/BSEE; Support: NOAA; Timeframe: Ongoing)

- **Reduce climate threats and improve the resilience of climate-vulnerable protected species, including marine mammals**
    - Advance research and monitoring technologies to support targeted protected marine mammal species management by enhancing our baseline understanding of marine mammal species' behavior and distribution, the influence of predator-prey interactions and oceanographic conditions on individual behavior, distribution, and population health; expanding research on climate change impacts on individual behavior, distribution, and population health; and differentiating animal behavioral and physiological responses to climate change from exposure to anthropogenic stressors. (Leads: NOAA, DOD/DON, DOI/BOEM, DOE; Timeframe: Ongoing)
    - Continue to use climate adaptation tools like vulnerability assessments and scenario planning to understand which protected species are vulnerable to climate change and why and to explore future management strategies and responses to near-term climate variability and long-term climate change. (Key Agencies: NOAA, DOI/FWS; Timeframe: Ongoing)
    - Build and strengthen national and international partnerships globally to advance a community of practice to ensure areas critical to protected species survival are safeguarded by an interconnected suite of protected areas and management measures. (Key Agencies: NOAA, DOI/FWS; Support: MMC, State/SPEC; Timeframe: Ongoing)
- **Enhance resilience of coral populations and coral reef systems with research and development of innovative techniques** to reduce the mortality of corals, build partnerships to help conduct restoration at ecologically meaningful scales, improve techniques that control the spread of coral diseases to help improve survival rates for corals at key reef sites, and implement and evaluate existing and emerging tools to forecast climate impacts and protect reefs by conferring resilience to impacts. (Key Agencies: NOAA, DOI; Timeframe: Ongoing)

Coastal Climate Resilience OCAP Actions to Enhance Resilient Communities

The OCAP includes the following objective for Coastal Climate Resilience to Bolster Resilient Communities*:*

Objective: Prepare coastal communities for the impacts of climate change through coastal resilience projects informed by expanded Federal data, products, and information. Engage with stakeholders to ensure equitable access to climate information products and services and promote nature-based solutions where appropriate.

To meet this objective, the OCAP sets forth the following high-level actions in bold, which can be advanced through the additional efforts and strategies described in more detail below.

- **Promote coastal community resilience strategies that are adaptive, equitable, and based on best practices**
    - Provide technical assistance related to climate services and data to support community planning with a focus on marginalized, underserved, and rural communities to increase accessibility of Federal programs. Use regional approaches to catalyze adaptation and expand engagement with these communities through IRA. (Key Agencies: NOAA, EPA, DOI/USGS, DOI/FWS, DOI/OIA, DOI/BIA; Support: NSF; Timeframe: Immediate (0-6 months) to initiate)
    - Integrate equity, green infrastructure, and nonstructural flood risk reduction in feasibility studies for Federal coastal flood risk management investments[207] (Key Agency: USACE; Support: NOAA; Timeframe: Immediate (0-15 months to initiate)
    - Co-develop collaborative research and engagement projects with coastal communities to build local capacity to adapt to climate change across complex physical and social coastal risks; improve approaches for engaging frontline communities to address coastal resilience through BIL and IRA. (Key Agency: NOAA; Timeframe: Ongoing)
    - Plan and construct coastal storm risk reduction projects that meet community needs, employ best-available science, including nature-based solutions, and protect ecosystems. (Key Agency: USACE; Support: NOAA; Timeframe: Ongoing)
    - Assess Federal coastal science-based tools and indices to evaluate equitable access and use of information and to develop best practices. Partner with agencies, Tribal, state, and local governments and partner organizations that support screening tools to assess Federal coastal science-based tools and indices to evaluate accessibility of critical decision-making information. (Key Agency: NOAA; Support: EPA, DOI/USGS; Timeframe: Immediate (0-6 months) to initiate)
    - Integrate Indigenous Knowledge and include Indigenous voices in coastal resilience research and management decisions; expand opportunities for co-stewardship

[207] Department of the Army. Memorandum for Commanding General, U.S. Army Corps of Engineers. Policy directive – Comprehensive Documentation of Benefits in Decision Document. (January 5, 2021). https://planning.erdc.dren.mil/toolbox/library/MemosandLetters/ComprehensiveDocumentationofBenefitsinDecisionDocument_5January2021.pdf.

agreements. (Key Agencies: NOAA, EPA, DOI/USGS, DOI/BIA; Timeframe: Immediate (0-6 months) to initiate and then ongoing)

- Maintain engagement feedback loops with communities by supporting regional-scale partnership and coordination efforts to understand and evaluate the success of coastal resilience projects, and share best practices. (Key Agencies: NOAA, DOI/USGS, DOI/FWS, DOI OIA; Timeframe: Immediate (0-6 months) to initiate)
- Maintain and enhance long-term partnerships with coastal States and U.S. Territories through the National Coastal Zone Management Program, National Estuarine Research Reserve System, National Sea Grant Program, and other initiatives to ensure they have the tools, resources, and best management approaches needed to enhance community resilience.
- In partnership with communities, Tribal, state, local, and territorial governments, identify coastal ecosystem migration pathways to ensure persistence of critical habitats that support coastal fisheries and wildlife (Key Agencies: NOAA, USACE, DOI/FWS; Support: DOI/USGS, HUD, FEMA; Timeframe: Immediate (0-6 months) to initiate)
- Leverage *EO 13985 Advancing Racial Equity and Support for Underserved Communities Through the Federal Government* to evaluate the integration of equity and climate justice requirements in Federal climate resilience programs and complementary public-private endeavors.[208] (Key Agencies: NOAA, NSF, DOI/USGS, USACE, EPA, DOE; Timeframe: Immediate (0-6 months) to initiate)
- *Shared Action (Climate-Ready Fisheries and Fishing Communities):* Co-produce and deliver the products, tools and assistance fishing communities need to assess risks, increase resilience, and adapt to rapidly changing ocean conditions, with a focus on supporting highly vulnerable and underserved communities. (Key Agency: NOAA; Support: DOI/USGS; Timeframe: Immediate (0-6 months) to become regular practice)
- Address energy resilience as part of coastal resilience through strategic energy planning with the DOE Energy Transitions Initiative Partnership Project (ETIPP) program working alongside remote, island, and islanded communities seeking to transform their energy systems (Lead agency: DOE, Timeframe: now)
- Incorporate climate resilience into the next Great Lakes Restoration Initiative 5-year Action Plan factoring in the recommendations from the Great Lakes Advisory Board. (Key Agency: EPA; Support: USDA, NOAA, DOI; Timeframe: 20 months)

- **Through the CR-IWG subcommittee on Community-Driven Relocation, support demonstration projects on community-driven relocation and decision processes**
  - Support community-driven relocation demonstration projects and decision processes with a whole-of-government approach to serve those expressing affirmative interest and provide equitable treatment of low-and moderate-income households, seeking relocation assistance. Ensure sufficient funding is carved out for real time assessment and evaluation of these demonstration projects to support active learning and adaptive management. (Key Agencies: CEQ, FEMA, DOI, HUD, DOT, and USDA; Support: CR-IWG Subcommittee on Community Driven Relocation, NOAA, EPA. USACE, NSF; Timeframe: 6 months – 5 years)

[208] Exec. Order 13895. Advancing Racial Equity and Support for Underserved Communities Through the Federal Government, https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/20/executive-order-advancing-racial-equity-and-support-for-underserved-communities-through-the-federal-government/, *reprinted in* 86 FR 7009 (Jan 25, 2021).

- Develop an approach for sharing government wide resources and information to support community-driven relocation effectively. (Key Agencies: CEQ, FEMA, DOI, HUD, DOT, and USDA; Support: Interagency Community-Driven Relocation Subcommittee; Timeframe: Within 12 months)
- Align policies across agencies to support socially-cohesive, community-driven relocation, by developing programs that provide incentives and support to communities interested in relocation due to the risks of flood inundation. (Key Agencies: NOAA, EPA, USACE, HUD, DOT, FEMA; Timeframe: 2 years to initiate)

- **Expand the range of coastal resilience and restoration project financing mechanisms available to frontline communities**
  - Expand the range of coastal resilience project financing mechanisms available to frontline communities in partnership with the private sector, community-based organizations, philanthropic, and faith-based organizations. (Key Agencies: NOAA, EPA, FEMA, DOI; Timeframe: Mid-Term (6 months-2 years) to initiate)
  - Expand Federal grant programs to help Tribal Nations, State, Territorial, and local governments, Indigenous Peoples, and NGOs optimize natural resource benefits by implementing nature-based infrastructure for resilience and adaptation and incorporate their perspectives and experiences into evaluation criteria. (Key Agencies: NOAA, EPA; Support: NSF, DOI; Timeframe: Immediate (0-6 months) to initiate)
  - Create and enhance tools to support coastal restoration finance, such as the EPA Environmental Finance Dashboard. (Key agencies: EPA, NOAA, USACE, DOI/USGS; Timeframe: Mid-term (6 months - 2 years) to complete)

- **Support transformational resilience investments in coastal habitat restoration, conservation and in coastal community resilience** by using BIL and IRA funds to carry out projects that benefit coastal communities, including those that have been historically marginalized, underserved, or underrepresented. Support to projects and communities should include technical assistance for making science-informed resilience investments, building enduring capacity, and engaging on the ground expertise to equitably reduce risk to coastal communities, economies, and ecosystems. (Key Agency: NOAA; Timeline: Ongoing)

- **Expand coastal mapping, monitoring, observational systems, research, and modeling to inform science-based decision-making capabilities and advance use of nature-based solutions**
  - Connect and augment existing Federal monitoring capacities, observational networks, modeling, predictions, projections, products, and services into an interoperable framework to inform decision-making, such as management plans, vulnerability assessments, and resilience toolkits; enhance tools to evaluate the effectiveness and opportunities for use of nature-based solutions (Key Agencies: NOAA, DOI, NASA, DOI/USGS, USACE, USDA; Timeframe: Immediate (0-6 months) to initiate)
  - Ensure that coastal observations, models, information products, and related services are co-designed across Federal agencies and with local governments, management agencies, and other stakeholders to ensure they are responsive to timing, information, and formats that are useful for decision-making. (Key Agency: NOAA; Support: DOI/USGS, NASA; DOI/BOEM; Timeframe: Immediate and ongoing)

- Expand and raise awareness of the National Offshore Sand Inventory and the Marine Minerals Information System to ensure all parties have access to detailed offshore sediment information critical to project planning and responsible decision-making. (Key Agency: DOI/BOEM; Timeframe: Immediate and ongoing)
- Ensure that coastal resilience science tools, products, and services are directly responsive to the needs of major granting agencies and their program applicants. (Key Agencies: HUD, EPA, NOAA; Timeframe: Immediate (0-6 months) to initiate)
- Foster community engagement and feedback with coastal communities on climate vulnerability assessments and tools, such as the White House Council on Environmental Quality (CEQ) Climate and Economic Justice Screening Tool (CEJST),[209] the Administration's Climate Mapping for Resilience and Adaptation (CMRA) portal,[210] and FEMA's National Risk Index,[211] to ensure accurate representation of risk in decision making, to identify communities and ecosystems most at risk, and to get input on how they can be improved over time to better meet Tribal, State, local, and Territorial information needs.
- Shared action (Climate-Ready Fisheries and Fishing Communities) - Expand regional monitoring of living marine resources to better track shifting distributions and changing productivity to inform climate-ready resource management. (Key Agency: NOAA; Timeframe: Immediate (0-6 months) to become regular practice).

- **Advance evaluation, and adoption of nature-based solutions, such as living shorelines, to build resilience against climate-driven coastal hazards**
  - Establish Coastal Resilience test beds that test novel coastal hazard mitigation and adaptation strategies. (Key Agencies: NOAA, EPA, DOD/ONR, DOD/DON, USACE; Support: FEMA, NSF; Timeframe: Immediate (0-6 months) to initiate)
  - Utilize interagency programs such as the National Oceanographic Partnership Program (NOPP) to understand and improve the predictive ability of extreme weather impacts, including flooding, coastal breaching, erosion, property destructions, and infrastructure loss. (Key Agencies: NOAA, DOD/DON, DOD/ONR, DOI/USGS; Timeframe: Immediate (0-6 months) to initiate)
  - Provide and improve real-time and predictive forecasting on short- and long-term landscape change and how coastal areas will be impacted during extreme storm events. (Key Agencies: NOAA, USACE, DOI/USGS; Support: NSF; Timeframe: Mid-term (6 months - 2 years) to initiate)
  - Identify, improve, and align existing Federal agency programs that include nature-based solutions, so that their products, information, and services are further tailored to meet end-user needs and responses to climate-driven coastal hazards. (Key Agencies: NOAA, EPA, DOI/USGS/BOEM/OIA, USACE; Timeframe: Immediate (0-6 months) to initiate)
  - Identify opportunities to leverage existing interagency groups to discuss collaborative nature-based solution research and demonstration projects across the Federal

[209] The White House. Climate and Economic Justice Screening Tool. https://screeningtool.geoplatform.gov/en/#3/33.47/-97.5. Last accessed March 2023.
[210] U.S. Global Change Research Program. Climate Mapping for Resilience and Adaptation. https://resilience.climate.gov/. Last accessed March 2023.
[211] FEMA. The National Risk Index. https://hazards.fema.gov/nri/. Last accessed March 2023.

Government, including collaborative research on coastal resilience. (Key Agencies: NOAA, EPA, DOD/DON, DOD/ONR, USACE, DOI/USGS/BOEM/NPS/OIA; Support: NSF; Timeframe: Mid-term (6 months - 2 years) to initiate)

- Support the inclusion of nature-based solutions in disaster recovery efforts and programs. Nature-based solutions as part of disaster recovery projects will increase the impacts and reduce the cost of future disasters. (Key Agencies: DOI, DOD, NOAA; Timeline: Ongoing)
- Coordinate with EPA and other Federal agencies to encourage use of State Clean Water State Revolving Funds to fund green infrastructure and nature-based solutions for investment in resilience and coastal protection projects. (Key Agency: EPA; Support: NOAA, USACE, DOI/USGS; Timeframe: Mid-term (6 months - 2 years) to complete)
- Expand upon relationships with the engineering community to incorporate innovation in coastal engineering practices and standards. Projects could include developing standards for various forms of "living shorelines" and demonstration projects in all regions of the country to catalyze much wider adoption by local governments and private developers. Additional projects could include development of marine energy installations that additionally serve to protect shorelines. (Key Agencies: NOAA, USACE, DOI/USGS; Support: DOE; Timeframe: Mid-term (6 months - 2 years) to initiate)

- **Expand Federal assistance through voluntary habitat conservation programs**
  - Identify barriers to community and Tribal engagement in habitat conservation and develop resources that promote inclusive conservation solutions. (Key Agencies: DOI/FWS, NOAA, EPA; Timeframe: Immediate (0 - 6 months) to initiate)
  - Increase funding opportunities (e.g., through competitive grants or cooperative agreements) to support established partnerships that are working directly with coastal communities and implement habitat restoration and protection projects that are building coastal resilience. (Key Agencies: DOI/FWS, NOAA, EPA, DOE; Timeframe: Mid-Term (6 months - 2 years) to complete)
  - Increase funding opportunities (e.g., through competitive grants or cooperative agreements) for monitoring of conservation action to assess effectiveness and to improve the science and delivery of habitat conservation. (Key Agencies: DOI/FWS, NOAA; Timeframe: Mid-Term (6 months - 2 years) to complete)

- **Enhance community resilience through the National Coastal Resilience Fund**
  - Through the Fund's competitive process, identify and support projects to increase protection of communities from coastal hazards, such as flooding and erosion, while also enhancing coastal habitats that are vital for fish and wildlife. The Fund prioritizes projects that address the disproportionate risks faced by communities on the frontlines of climate change and projects that are community led or incorporate direct community engagement. In FY23 the Fund will invest approximately $140 million in grants to support nature-based coastal resilience solutions. Key Agency: NOAA; Support: DOD. Timeline: Ongoing

- **Reduce threats to coastal and Great Lakes ecosystems that are exacerbated by climate change, including invasive species and harmful algal blooms**

- Provide Great Lakes resource agencies Aquatic Invasive Species Ecological Risk Screening Summaries to identify highest-risk aquatic species that are not yet present in the Great Lakes basin but that have a history of invasiveness and a climate match to the Great Lakes region. (Key Agency: DOI/FWS; Timeframe: Ongoing)
- Advance the experimental hypoxia forecast into operations and expand the harmful algal bloom monitoring network and modeling to see impacts from blooms in the Lakes. In the next five years, the hypoxia forecast will be operational, including expanding work in Lake Huron (NOAA) and new areas such as Lake Superior (EPA). New toxins are also being considered as the phytoplankton community changes (NOAA, DOI/USGS). Advanced and emerging technologies are being tested and validated in the Great Lakes for monitoring, prevention, and control of HABs (NOAA and USACE). (Key Agencies: NOAA, EPA, DOI/USGS, USACE; Timeframe: Ongoing)
- Understand the relationship between HABs and additional factors affected by climate change and extreme weather events in the Great Lakes (i.e., salinity, temperature, acidity, nutrients). Additional environmental stressors that impact the Great Lakes region can potentially alter or influence HAB production and response to mitigation, prevention, and monitoring efforts. (Key Agencies: NOAA; Timeframe: Ongoing)
- Advance and expand our ability to monitor and forecast HABs and hypoxia along our coasts. (NOAA; Timeframe: Ongoing)
- Provide real-time scenario modeling and other decision support tools to inform nutrient runoff reduction in the Mississippi River Watershed and expand the coverage of real-time Runoff Risk Decision Support across upstream states, reducing risk of downstream HABs and hypoxia. (Key Agencies: NOAA, EPA, Support: DOI/USGS Timeframe: Ongoing)
- Collaborate on the implementation and evaluation of the effectiveness of nature-based solutions to reduce nutrient pollution in conjunction with broader coastal resilience goals (Key Agencies: NOAA, EPA, Support: DOI/USGS; Timeframe: Ongoing).
- Track and act on observations of new and existing invasive species within the Great Lakes region through the Great Lakes Aquatic Nonindigenous Species Information System. Improving long-term monitoring efforts and cataloging observations on biological, chemical, physical, social, and economic variables affected by invasive species will help to develop and improve risk assessments for the region. (Key Agencies: NOAA, DOI/USGS, EPA; Timeframe: Ongoing)
- Understand the ecological impact of an invasive species introduction into the Great Lakes to inform prioritizing resources and action. Agencies work through the Invasive Carp Research Coordination Committee (ICRCC) to use data collected by NOAA GLERL's Long Term Research program, and other Great Lakes time-series from other agencies, as inputs to computer simulation models to predict where in the Great Lakes invasive carp would establish if they are introduced, and project effects of invasive carp on Great Lakes food webs. (Key Agencies: NOAA, USACE, DOI/USGS/FWS/NPS, EPA, DOT, USCG; Timeframe: Ongoing)
- Develop effective early detection and rapid response tools (chemical and physical) for monitoring, containing, and controlling invasive species. Maintenance and recovery of Great Lakes fisheries, biodiversity, ecosystem functions, and services will require the management of new and existing invasive species, as quickly as possible. Environmentally-acceptable chemical, physical, and biological control methods,

including attractants and repellents need to be developed to address other established invasive species. Effective early detection and response will also require regionally-coordinated surveillance monitoring programs undertaken over appropriate time scales. (Key Agency: NOAA; Timeline: Ongoing)