# Pacific Northwest Perspectives on the US Ocean Climate Action Plan

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## Executive Summary

The Greater Pacific Northwest is looking toward the innovative solutions outlined in the Ocean Climate Action Plan to develop a sustainable Blue Economy and meet the region's climate goals. This paper will explore several approaches to achieving decarbonization in the Blue Economy, with a focus on maritime decarbonization, ocean renewable energy, and using marine carbon dioxide removal and nature-based solutions.

Successful implementation of these strategies will require the region to come together. On September 20, Washington Maritime Blue (Maritime Blue), in collaboration with Pacific Northwest National Laboratory (PNNL), convened the *Putting the 'Action' in the Ocean Climate Action Plan* workshop. The goal was to better understand how the Greater Pacific Northwest ocean climate action network can leverage our strengths and existing efforts to collaborate more effectively and use the Blue Economy to contribute to decarbonization.

As a cluster organization deeply committed to propelling maritime innovation and sustainability, and with members and partners that include research and academia, private industry, community-based organizations, and public entities, Maritime Blue was selected as the lead convener for this workshop.

### WHAT IS THE BLUE ECONOMY?

The Blue Economy, according to the World Bank, is the "sustainable use of ocean resources for economic growth, improved livelihoods and jobs, and ocean ecosystem health." Maritime Blue further expands this definition to include the maritime and ocean technology sectors and shoreside activities related to ocean-based climate solutions. This may include activities related to ports, shipping, trade, the movement of goods, vessels, marine energy, fishing and seafood, and marine conservation operated in a way that is sustainable, equitable, and profitable.

Common themes emerged through this workshop as pillars for success — collaboration, research, investment, and workforce development. This report details these themes and how they address the primary challenges related to ocean climate action and provides additional workshop-identified recommendations. These include increasing partnerships, engaging communities early on, celebrating failures and successes, and striving for resilience.

These recommendations culminated around the need for enhanced organization toward ocean climate action goals, and the possibility of achieving this through the establishment of a Center of Excellence for Ocean Climate Action in the Greater Pacific Northwest. This hub would serve as a central point for collaboration, research, and development, aligning with the region's commitment to lead the nation toward a decarbonized future.

## Acknowledgments

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Washington Maritime Blue would also like to express another special thank you to all the representatives of the following organizations who attended the Ocean Climate Action Plan workshop.

Ebb Carbon

Carbon 180

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Marine Situ

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Lodestar Partners

Oscilla Power

Alaska Blue Economy

Renewable Northwest

COAST

Paradigm Climate

The Blue Green Alliance

The U.S. Department of Energy

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48 North Solutions

Booz Allen

Climate Ingenuity

SMI

Simply Blue Group

Oregon Business Council

Snow & Co.

PacWave South

Yellow Drake Consulting

## Introduction

The Greater Pacific Northwest (PNW) region is ideally positioned to activate the power of the ocean to achieve decarbonization goals in a sustainable and equitable way. Ocean climate solutions could add new green electrons to the grid, reduce carbon intensity in maritime operations, and protect coastal ecosystems that support carbon storage and sustainable seafood, while adding new jobs and bolstering economic and energy resilience for coastal communities. These opportunities will require stakeholders to work together to design solutions that work for communities and overcome technical and financial challenges.

On September 20, 2023 Washington Maritime Blue (Maritime Blue), collaborating with the Pacific Northwest National Laboratory (PNNL), convened the workshop *Putting the 'Action' in the Ocean Climate Action Plan,* exploring how the PNW can support the federal government's climate initiatives and, at a regional level, take impactful steps forward.

Maritime Blue is a 501(c)3 cluster organization and a strategic alliance that aims to drive innovation and sustainability, while supporting a thriving and inclusive Blue Economy. Maritime Blue accomplishes this mission through convening its extensive network in knowledge-sharing, innovation, entrepreneurship, business development, and workforce growth, with a focus on making the maritime and ocean industry not only sustainable but equitable as well. It's members and partners include private industry, the public sector, community organizations, and research and training institutions.

Pacific Northwest National Laboratory (PNNL) is a United States (U.S.) Department of Energy (DOE) national laboratory whose goal is solving the world's greatest science and technology challenges. PNNL's research aims to advance sustainable energy, like decarbonization and energy storage, and boosting national security. Working with partners, PNNL aims to take their research findings to market so we all can benefit from their innovative work. PNNL operates the DOE's only dedicated marine science laboratory on its PNNL-Sequim campus and is working closely with other national labs, universities, industry partners, and coastal communities to advance U.S. government decarbonization goals through ocean climate pathways.

## What is the Ocean Climate Action Plan?

In March of 2023, the Biden Administration released the first U.S. "whole of government" Ocean Climate Action Plan (OCAP), which provides the federal government with an interagency blueprint to leverage the power of the ocean to abate emissions and mitigate climate change. The plan, for the first time, merges ocean policy goals with the broader set of pathways necessary to decarbonize the economy and respond to the climate challenge. OCAP lays out ocean-based climate actions that can be used to meet its three goals (see text box on next page).

All the actions in OCAP prioritize climate solutions, environmental justice, job creation, community resilience, and a sustainable blue economy. OCAP also uses six principles to help guide ocean-based policies, programs, and funding:

- Ocean Health and Stewardship
- Environmental Justice
- Engaging with Tribal Nations and Indigenous People
- Outreach and Engagement
- Science Evidence and Knowledge
- Interagency Coordination

**OCAP GOALS**

- Create a Carbon-neutral future.
- Accelerate nature-based solutions.
- Enhance Community Resilience to ocean change.

These principles are intended to ensure that decisions are rooted in facts, equity, justice, collaboration, and sustainability.

Given the importance of ocean climate action, it will take significant collaborative efforts across the country to achieve OCAP's goals. This action will be necessary at a national and region-to-region level but also at the more local level. By leveraging each levels specific strengths and identifying unique challenges, regions will be able to meet OCAP's objectives and provide benefits to their communities in alignment with their needs. Additionally, this will enhance their ability to participate in higher-level collaborations more efficiently.

## The Pacific Northwest Region

The PNW has a unique network of federal agencies, industry, academic researchers, tribes, communities, and decision-makers that, when working together, can successfully act and meet OCAP's goals. This makes the region well situated to be a national leader in enacting the actions laid out in OCAP.

The PNW is home to many maritime industries, including one of the busiest and largest container ports in the United States, a thriving shipbuilding and maintenance sector, and leading fishing and seafood processing industries. Abundant hydropower, wind, and solar resources contribute to a uniquely high penetration of renewable energy, providing opportunities for green fuels and port electrification. The region also has a track record of public-private sector partnerships supporting world class technology and manufacturing expertise. And a large research community thrives in the region with several major universities and federal laboratories conducting research to understand the ocean's role in climate solutions. Perhaps most importantly, the PNW is also home to diverse communities, including sovereign Tribes and Indigenous Nations, that are ready to act on climate change and can help to push ocean climate action forward.

The purpose of the *Putting the 'Action' in the Ocean Climate Action Plan* workshop was to bring together the PNW's network of industry experts, community members, and thought leaders to explore opportunities for ocean climate action. Due to the unique expertise and current opportunities within the PNW region the workshop focused on the first goal of OCAP, **to create a carbon-neutral future.**

The workshop featured three panels of experts discussing various aspects of reaching a carbon-neutral future:

1. Maritime Decarbonization
2. Ocean Renewable Energy
3. Marine Carbon Dioxide Removal and Nature-Based Solutions

Compiling the perspectives and insights shared by the panelists and attendees, the upcoming sections provide an overview of each topic, the major challenges that need to be addressed, and an initial impression of current and future opportunities. An additional appendix shows data from polls conducted during the workshop, providing insight into what attendees thought about these topics and the PNW's commitment to using the ocean to combat the climate crisis.

## Maritime Decarbonization

### Green Shipping as a Pathway to Maritime Decarbonization in the Blue Economy

Green shipping is a critical maritime decarbonization strategy to help mitigate the climate crisis. Large transport and cargo ships are responsible for 80% of global trade by volume according to the International Maritime Organization (IMO), which led to the sector emitting 3% of global emissions (ICCT, 2023). In 2018, the IMO set a goal to cut GHG emissions by at least 50% by 2050, necessitating a shift away from traditional fuels. Green shipping involves reducing carbon dioxide ($CO_2$) emissions by utilizing sustainable, low to zero-carbon emitting power sources on vessels. Given the vital role the maritime industry plays in trade and supply chains, green shipping is needed to impactfully reduce greenhouse gases (GHG) in the atmosphere.

Green shipping options currently include electrification, hydrogen-based fuels, biofuels, and liquefied natural gas (LNG). Electrification and hybridization, using batteries, generators, and electric motors, is gaining popularity but is currently only suitable for smaller and short-range vessels. Hydrogen-based fuels are considered promising, with clean and scalable attributes, but face challenges such as cost, availability, and safety concerns. Biofuels, derived from biogenic feedstock, present a cleaner alternative for internal combustion engines, but scaling production and reducing costs are challenges. LNG, while abundant and affordable, has limitations due to methane's potency as a GHG, and is widely discussed primarily as a transitionary fuel rather than a long-term solution.

Long-term change in green shipping requires continued research and development efforts to validate alternative power sources because there is no widely agreed upon fuel or battery solution to meet the sector's needs. A transition to a mix of renewably generated hydrogen-based fuels and biofuels, and renewable-charged batteries could potentially power the maritime industry within a decade or two, contributing to a sustainable and environmentally friendly future.

### Gaps and Barriers Identified by Workshop Panelists

Panelists for Maritime Decarbonization included representatives from federal and local governments, a naval architecture and marine engineering firm, a green vessel certification firm, and a maritime logistics marine and energy solutions company; respectively the organizations included the Port of Seattle, Department of Energy, Elliot Bay Design Group, Green Marine, and Crowley. These panelists identified several key challenges that must be overcome to make green shipping a reality. Five main gaps and barriers identified at the workshop are listed below.

**Shipyards' Lack of Capacity**: Shipyards in the PNW need further investments to meet the demand to build and maintain the required quantity of new low to zero emission vessels.

**Infrastructure and Maintenance Coordination**: Vessels have a long lifespan, and maintaining and coordinating the necessary maintenance infrastructure, and fuel or power infrastructure, is vital. Owners and operators of these vessels need to coordinate with shipyards, fuel providers, and ports to ensure the infrastructure required to maintain, operate, and power these vessels will be available throughout their lifetime.

**Research**: Further research is necessary to determine the most effective fuel or power source for each of the different vessel types, especially for long-range vessels requiring significant energy and traveling large distances between ports of call. Additionally, the technologies used to transition vessels are not always designed for maritime purposes. Research and development are needed to marinize existing technologies and design new technologies specifically for maritime use cases.

**Co-opetition**: While competition is essential, vessel developers, owners, and operators should collaborate and share their experiences to streamline the manufacturing processes and quickly bring successful low to zero emission vessel designs to the market.

**Workforce Development**: The maritime industry is facing a workforce and staffing shortage. Maritime industries need to increase their recruitment to replace and increase their current workforce capacity. There is also a need for additional training for the existing workforce on low to zero emission vessel technologies to ensure that a green shipping industry will thrive.

## Ongoing Maritime Decarbonization Activities

Efforts to innovate and develop green shipping are important to pursue now. A few initiatives are underway in the PNW to pursue green shipping as a pathway to decarbonization – green corridors, electrification of ports and waterfronts, and development of low to zero emission vessels.

**Green Corridors**: There are two feasibility studies and related analyses underway in the PNW to assess maritime routes (green corridors) where low to zero emission technologies can be considered, tested, and supported. Green Corridors are collaborative processes, that establish the technical, social, and policy framework for low emission services between at least two ports of call on a given shipping route. Both corridors under consideration in the PNW are still in the investigatory/pre-feasibility phase.

For more information, please visit: PNW2AK Green Shipping Corridor and Busan to NW Green Corridor

**Port and Waterfront Electrification**: Multiple studies and planning processes are underway at ports and waterfronts across the PNW to reduce emissions from vessels, transportation, and equipment that are necessary for their operations. The Northwest Ports Clean Air Strategy is one example of regional collaboration to understand electrification and emission reduction approaches and was adopted by the Port of Seattle, Port of Tacoma, Northwest Seaport Alliance, and Vancouver Fraser Port Authority to reduce their emissions.

For more information, please visit: Northwest Ports Clean Air Strategy

**Low to Zero Emission Vessels**: Several low to zero emission vessel development projects are in progress in the PNW, including a methanol-hybrid tugboat, a methanol-to-hydrogen electric tugboat, an electric foil ferry, the conversion of Washington state ferries to hybrid-electric propulsion, and a hybrid electric research vessel.

For more information, please visit: The Methanol-hybrid Tugboat, Methanol-to-hydrogen Electric Tugboat, Electric Foil Fast Ferry, Washington State Ferries Electrification Project, and Hybrid Electric Research Vessel.

## Ocean Renewable Energy

### Offshore Wind & Marine Energy

There are two primary types of ocean renewable energy being explored globally and identified in OCAP:

> **Offshore Wind Energy:** Offshore wind involves placing wind turbines in the ocean, either fixed to the seabed or floating on platforms, to generate power using consistent and strong ocean winds.
>
> **Marine Energy:** Marine energy uses the natural movements of the ocean, including waves, currents, and tidal forces, to produce power. It can also harness energy from differences in pressure, temperature, and salinity in the ocean.

The ocean has a huge potential to generate renewable energy and reduce our reliance on fossil fuels. According to the Department of Energy, offshore wind and marine energy projects using current technologies have the potential to produce 4,000 GW and 400-800 GW of energy projects respectively, adding valuable energy to the grid (Kilcher, Fogarty, & Lawson, 2021; Lopez, et al., 2022). And ocean renewable energy can also create opportunities for energy resilience for near-shore communities, a thriving economy, and more jobs for communities here in the PNW.

### Offshore Wind

The United States is actively pursuing offshore wind development along its coasts, driven by an ambitious goal set by the White House to achieve 30 gigawatts of offshore wind energy by 2030. This goal aims to provide clean renewable energy to power millions of homes but also aims to generate 77,000 new jobs and attract increased investments across the United States (The White House, 2022).

On the west coast, the offshore wind sector is in its early stages but is poised for rapid growth. Deep waters off the west coast don't allow for conventional offshore wind technologies, leading developers to research and develop floating offshore wind technologies (FOSW). FOSW is still an emerging technology with only five farms operating or being constructed and a few other sites testing different prototypes (Williams & Feng, 2023). West coast states can be global leaders and first movers for supply chain development for FOSW. The DOE is proactively addressing the challenges involved in accelerating FOSW development on the west coast. To facilitate this development, the DOE has launched the Floating Offshore Wind Shot program, designed to expedite breakthroughs in engineering, manufacturing, and other innovation areas. The program aims to achieve a substantial reduction in the costs of these new technologies by more than 70% by 2035.

The DOE aims to expedite FOSW projects to meet the White House's goals and jumpstart the long project development lifecycle for FOSW projects (eight to ten years

from leasing to beginning of operations). Additionally, states are also advancing the necessary legislation and regulatory mechanisms now to set up the infrastructure, the supply chains, and the workforce; this will enable FOSW to move forward with connecting these projects to states' grids.

Currently on the west coast, the federal government is leasing sites to energy developers in California and is in the process of considering lease areas in Oregon. California has set a goal to produce 25 GW of energy from offshore wind by 2045. If the goal is met, offshore wind will provide renewable energy to 25 million homes by 2050 (California Energy Commission , 2022). California is moving quickly and has successfully held five site auctions. Developers of these sites are beginning to perform site assessments and surveys to ensure regulatory compliance and understand their environmental impact (BOEM, 2023). Oregon has also set a goal to develop three GW of offshore wind energy by 2030 (Oregon.gov, 2023). Two sites off the Oregon coast have been selected, and an auction will be held in 2024 (BOEM, 2023). Washington State is also beginning to move on offshore wind with two unsolicited lease proposals from companies interested in developing projects off its coast.

## Marine Energy

Offshore wind is a more developed technology and industry due to early movers across the globe, compared to its marine energy counterpart which is still early in its development. There are no operational, commercial, utility-scale marine energy farms in the United States, although devices have been deployed at demonstration and testing sites.

For example, PacWave, located in Oregon, is being established as an open ocean wave energy test bed for researching and developing wave energy technologies. PacWave aims to be operational in 2025, and will house 20 devices to test their capabilities, assess ecosystem impacts, and advance their research and development towards creating utility-scale devices ready to serve more communities (PacWave). Additionally, researchers at PNNL are conducting studies to further advance tidal energy. Through their research and partnerships, PNNL's work aims to aid in future site selection, estimation of resource requirements, advancing the technology, understand possible environmental impacts, and contribute to international standards. This work is foundational to successfully deploying tidal energy in the future.

## Gaps and Barriers Identified by Workshop Participants

Panelists for the Ocean Renewable Energy discussion include representatives from a major university, federal and local governments, a 501(c)3 organization, an offshore energy developer, and a marine energy testing site; respectively the organizations include Oregon State University, Department of Energy, Port of Seattle, Pacific Ocean Energy Trust, Oscilla Power, and PacWave South. These panelists identified several key

challenges to make ocean renewable energy a reality. Five main gaps and barriers identified at the workshop are listed below.

**Increase Public Funding and Private Sector Investments:** Additional investment and funding are needed in ocean renewable energy to develop, test, and scale the technologies and the infrastructure required to support them. Increasing funding can help to expand this sector and reduce our emissions more quickly. But the government does not have the resources to support full-scale deployment. The offshore wind experience on the U.S. east coast demonstrates the economic challenges associated with large scale infrastructure deployment in the ocean. Public sector sources of funding are necessary to bridge gaps in the early phases of technology development, while private investment is needed to scale up and deploy technology from demonstration and beyond.

**Lack of Regional Collaboration:** Collaboration among government, industry, academia, and communities is needed to formalize a strategy for ocean renewable energy in a way that effectively meets energy needs, minimizes community impacts, and ensures these new industries are developed sustainably and equitably.

**Supply Chain Needs:** A strong functional supply chain is crucial to deploy ocean renewable energy. Particularly, an initial focus needs to be on key areas of the supply chain, including manufacturing materials, infrastructure updates at ports for assembly and deployment, and Jones Act compliant shipbuilding and vessels.

**Mechanism to Permit New Technologies:** Permitting in the marine environment can be complicated for new technologies because there is a lack of information on their risks and potential ecosystem impacts. Using pre-permitted sites to test these technologies can help showcase their capabilities; understand and reduce the associated risks; and build trust with our communities around the technologies and the benefits these projects can provide.

**Workforce Development:** The ocean renewable energy sector has a shortage of skilled workforce and staffing. Since this sector is still in its early stages of development in the United States, it is difficult to anticipate the exact workforce needs and their requirements to plan for the timely implementation of training programs. For example, the ongoing research and development in platform and anchor technology for FOSW to identify the leading FOSW technologies, indicates the continued uncertainty of the final product which complicates training initiatives.

## Opportunities to Advance Ocean Renewable Energy

Ocean renewable energy development is an exciting opportunity for the energy sector and other industries. The federal government has created incentives to develop ocean renewable energy if developers meet specific benchmarks, including requiring U.S.-based manufacturing and financing to develop U.S.-made low to zero emission vessels to deploy and maintain projects (The White House, 2023).

Given ocean renewable energy projects' unique needs, collaborations across the blue economy sectors and establishing new relationships with underserved communities will be critical to their deployment. Prioritizing efforts to strengthen collaborations in ocean renewable energy is vital to ensure the most successful and sustainable future. Below are a few areas where opportunities exist for collaboration in the PNW.

**Co-location**: Co-location uses different energy generation technologies at the same site to increase the energy generated within a smaller area and to minimize the distribution of potential impacts. One exciting example is technology being developed to use offshore wind turbines to power the production of green hydrogen from seawater. The hydrogen produced can then be turned into sustainable fuel sources for use in sectors like green shipping, or to minimize the amount of under-sea cabling required to get the energy generated from the offshore wind farm to shore.

**Scalability:** The scale of each project is important to consider when developing and funding ocean renewable energy. Developing utility-scale projects and technologies holds the most potential to reduce emissions while minimizing costs. However, rural and underserved communities can utilize small-scale projects, which is equally important. These smaller projects provide opportunities for communities to develop needed infrastructure and create jobs. Smaller-scale projects can also show investors that technologies are functional and worth pursuing on larger scales.

**Partnerships:** Ocean renewable energy technologies could power maritime industries at sea without burning fossil fuels or returning to shore to plug into a waterfront electrical source. Research vessels and projects like marine carbon dioxide removal, are ideal for collaborations with ocean renewable energy technologies. When brought together, these distinct ocean climate actions can multiply their impact.

## Marine Carbon Dioxide Removal and Nature-Based Solutions

### Marine Carbon Dioxide Removal (mCDR)

mCDR are techniques that supercharge a natural process of the ocean that removes atmospheric carbon dioxide ($CO_2$) and stores it for an extended period. OCAP describes an effective mCDR technique as a process that reliably removes $CO_2$, sequesters it for decades, minimizes environmental and social impacts, and adheres to DOE's Carbon Negative Shot guidelines for scalability and cost. Currently, there are many mCDR approaches being explored and they vary in scientific maturity, knowledge gaps, environmental concerns, and deployment barriers.

mCDR is considered vital by the international community for achieving carbon reduction goals, as current levels of primary-emitting sectors' emission reductions are insufficient to meet international climate goals (IPCC, 2022). Additionally, mCDR allows sectors that are more challenging to decarbonize in the near term due to their rising demand, like energy and manufacturing, an opportunity to fund mCDR companies and abate their own emissions (IPCC, 2022).

mCDR is not a new concept, with some projects already underway around the globe. However, no commercial scale projects have been started in the United States. The federal government is looking to expand research so they can begin to understand how to incentivize growth and regulate the industry effectively.

### Nature-Based Solutions

Nature-based Solutions are another tool to meet the goal of a decarbonized future. Nature-based solutions use the conservation of habitats and organisms to naturally store carbon and improve ecosystems. One example of a nature-based solution in the PNW is kelp conservation in our coastal waters. Kelp absorbs carbon dioxide as it grows, holding it for some time and keeping it out of the atmosphere.

Nature-based solution efforts will play a significant role in our climate mitigation and adaptation efforts. Climate mitigation goals are met by physically sequestering carbon, which will reduce the concentration of $CO_2$ in the atmosphere. Climate adaptation goals are met by conserving marine environments and ensuring marine biodiversity. Nature-based solutions do both while also providing essential ecosystem services such as erosion control, deflection of storm surges, habitat restoration, and many others.

### Gaps and Barriers Identified by Workshop Participants

Panelists for the Marine Carbon Dioxide Removal discussion included representatives from the federal government, an mCDR company, and a major university; respectively the organizations include PNNL, National Oceanic and Atmospheric Administration, Ebb Carbon, and Washington Sea Grant through the University of Washington. These panelists identified several key challenges to make mCDR a reality. Four main gaps and barriers identified at the workshop are listed below.

**Collaboration:** A barrier to advancing research and implementing mCDR and nature-based solutions is a lack of organized collaboration among federal, state, and local agencies with private industries and non-governmental organizations. For example, increased collaboration between developers of ocean observation sensors and researchers will ensure that the sensing technology can provide critical data to better understand which mCDR strategies work best.

**Permitting:** New industries and technologies can be challenging to permit in the marine environment. There is a lack of safe, well-characterized, and accessible areas to test these technologies and methodologies to understand their effectiveness.

**Investment & Funding:** mCDR and nature-based solution efforts are still in the early stages of research and development; investment and funding is needed to continue their development. Pathways for organizations to showcase mCDR and nature-based solutions need to be prioritized to incentivize an increase in investment.

**Workforce Development:** The workforce challenges for mCDR are currently in the research sector. The research community faces a technical capacity shortage, hindering its ability to stay ahead of mCDR companies who are rapidly growing and advancing. Particularly, there is a lack of specialized STEM workforce training specifically for mCDR technologies. Additionally, a focus on recruiting and training test engineers and other professionals with hands-on experience is crucial. Bridging this workforce development gap is essential to fostering sustainable advancements and mitigating risks associated with the evolving landscape of mCDR.

## Opportunities to Advance mCDR

As mentioned above, mCDR and the implementation of marine nature-based solutions are in their early stages. Here in the PNW, one example of an early mover in mCDR technology is Ebb Carbon. Ebb Carbon is currently testing their technologies at PNNL and the project is expecting to have the capacity to remove 100 tons of $CO_2$ from the atmosphere per year when they reach full-scale implementation at PNNL's campus (Wendel, 2023). The testing taking place at PNNL will allow researchers to better understand how these technologies can sequester carbon safely. Once the concept is proven, Ebb Carbon can start to scale up and continue to remove excess carbon dioxide from the atmosphere on a much larger scale.

As more organizations continue to research and develop mCDR technologies, there are many areas to collaborate and take action to advance mCDR, below are three areas where advancement can occur.

**Research:** There is a need to continue to advance mCDR and nature-based solutions research and understand the most effective mechanisms to remove and store carbon from our atmosphere. Collaborations and work agreements between researchers across laboratories can play an essential role. These organized collaborations will allow researchers to work between different labs more effectively and reduce the time spent on developing a work plan. Collaboration between these researchers and labs will allow for easier data collection, data sharing, and more robust solutions in the future.

**Industry Collaboration:** Sensor development is another crucial sector to invest in to advance mCDR and nature-based solutions. Researchers and industries can collaborate to develop more advanced sensors to monitor carbon storage capabilities. Monitoring carbon during transportation and eventually into the chosen storage mechanism is important to understand storage efficiency and prevent leakage. A leak from a storage site poses a risk to the local environment, and monitoring devices and safety protocols will be essential to mCDR's success.

**Reducing Technology Silos**: Partnerships across sectors and organizations will be crucial to advance mCDR and Nature-Based Solutions. One such example would be utilizing Marine renewable energy as onsite power for mCDR projects. Small-scale, onsite, marine renewable energy could reduce the need for grid connectivity, minimizing sub-sea cables as well as reliance upon a grid that that may not be powered entirely by clean energy sources.

## Bridging the Gaps

### Identifying and Summarizing Existing Gaps

The gaps and barriers presented at the *Putting the 'Action' in the Ocean Climate Action Plan* workshop showed similar themes across each topic. As ocean climate action advances, understanding these themes will be vital to ensure the actions taken will meet the goal of a decarbonized future.

***Collaboration and Community Engagement:*** Collaboration is crucial, but can be time consuming, challenging, and expensive. One of the main themes consistent across all topics was the value and importance of effectively collaborating across the region. As one of our speakers quoted, "If we need to go far, we go together." Industry, government, research/academia, and communities in the PNW and throughout the West Coast must find ways to utilize each others' resources and expertise.

The workshop was an excellent first step to collaborating as a network. Having so many experts within one room to speak about their current work and perspectives on the future allowed for idea sharing on a large scale. Looking to the future, having a space to continue these connections will be crucial. Additionally, implementing a set of systems to collaborate across agencies, industries, and research labs will be helpful to collaborate more effectively.

***Research***: The advancement of each topic area will take continued research efforts to gain a better understanding of the topic, develop the technologies, create sustainable manufacturing mechanisms, and form strategies for deployment. Research needs to be informed by industry and community expertise in real-world applications. Additionally, researchers can more effectively communicate their findings to industry and communities when collaboration mechanisms are formally in place.

Research is also necessary to continue understanding how the development of these sectors will impact the environment and our communities. The impact of human activities that were not carefully considered has had negative consequences. The PNWs ocean climate action professionals must be mindful of any action taken to ensure a sustainable future for the environment and communities.

***Investment***: Strong investment across these sectors is necessary. But investment in new and emerging areas can be high risk and new technologies and sectors can lead investors to determine the risk is too great. The path forward for all ocean climate action sectors will be to find ways to reduce the risk of new and relatively untested technologies. Developers of these technologies need to find ways to showcase the functionality, efficiency, and scalability of their products to

increase investment opportunities. Due to these challenges investment and funding across both the public and private sectors is necessary. Public funding is essential to buy down risk, bridge gaps, provide foundational knowledge, and support early demonstration. Private sector investment is necessary to bring technology to the market to achieve the scale necessary for climate impact.

***Workforce Development***: The workforce is the backbone of success for all industries. Effectively developing the Blue Economy workforce must prioritize justice, equity, diversity, and inclusion. This will mean expanding recruitment efforts to bring new people and communities into the sector and ensuring that the near-shore communities most impacted by the effects of climate change are provided with opportunities to be a part of the solutions.

Workforce development programs providing relevant training will need to increase their efforts and develop new programs to keep up with the growing workforce. Additionally, these sectors are designing innovative and unique technologies that will require specialized workforce training to ensure the expertise to maintain them is ongoing. New and ongoing workforce development programs will need to form strategies to adjust for the continued development of technology going into the future.

## Recommendations

Through the discussions at the workshop, multiple recommendations emerged to address the gaps and challenges. The four broad recommendations below are suggested actions for the PNW to take to effectively engage with one another and drive forward ocean climate action.

**Increase High Quality and Sustained Partnerships**: Partnerships are essential for achieving the most sustainable outcomes for our climate, industries, communities, and the future. These collaborations enable tackling monumental challenges that no single organization can address alone, leading to more efficient use of both public and private sector funds by minimizing redundant efforts and sharing capacity. Partnerships also facilitate mutual learning within industries and create opportunities for joint ventures as competition intensifies.

***Addresses: Research, Collaboration, and Investment.***

**Engage Communities**: The time to bring in communities and stakeholders is now. Early engagement actions will help inform our strategies and ensure we all have a say in the collective future.

***Addresses: Collaboration and Workforce.***

**Celebrate Failures and Successes:** Ocean action professionals must strive to build trust to share both failures and successes within the ecosystem. Sharing

failures and successes can ensure that all ocean climate action sectors progress efficiently and that the implementation strategies prioritized are the most effective to meet our climate goals.

***Addresses: Collaboration and Research.***

**Strive for Resilience:** Prioritizing resilience in research efforts, business practices, and infrastructure systems is crucial, particularly when considering community resilience and community energy resilience. Resilience, defined as the capacity to withstand or recover quickly from difficulties, is essential for addressing the challenges posed by ocean climate action. It is imperative that actions not only adapt to these challenges but also contribute to the resilience of the communities involved, ensuring their ability to withstand and recover in the face of environmental and energy-related challenges.

***Addresses: Workforce and Investment.***

Incorporating these recommendations is the first step to solving the gaps and challenges associated with ocean climate action. Workshop participants discussed forming an Ocean Climate Action Center of Excellence in the PNW as a mechanism to sustain effort toward achieving OCAP's goals (Figure 1). A Center of Excellence (CoE) could allow action leaders and community members to see the work being developed and implemented on ocean climate action and more easily collaborate with one another.

A CoE can be virtual or developed in a physical place that brings together ocean action stakeholders. A virtual center would utilize various online tools to bring together a network to meet, collaborate, and share insights continuously. Though in-person gatherings would still happen in a virtual CoE model, the CoE wouldn't necessarily have a physical homebase, although it could support and coordinate activities occurring at regional testing and demonstration sites. While incorporating virtual space, a physical CoE can be a place to gather for meetings and pursue research and development. Additionally, the physical space can provide pre-permitted sites that can be used to test new vessels, renewable energy devices, and conduct needed mCDR research.

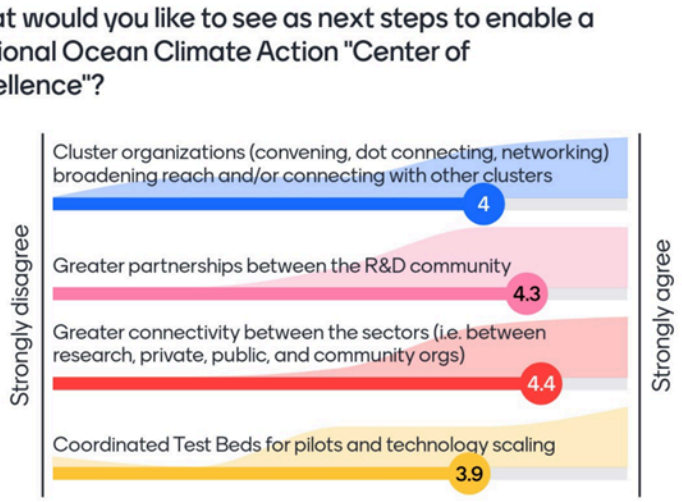



Figure 1: This poll shows the workshop participants view on what should be prioritized to advance a CoE. Participants strongly agreed that increased partnerships, increased communication, and greater coordination are all key priorities.

Overall, the CoE can ensure we all act and successfully implement a cohesive strategy to lead the PNW and country into a decarbonized future. Responsibility for facilitating, operating, and hosting a CoE could be shared between multiple organizations through an MOU, particularly in the instance a virtual CoE is pursued; though ultimately, having a single entity responsible for its execution can be valuable to ensure its effective progress.

## The Role of Cluster Organizations

As a Blue Economy cluster organization, Maritime Blue is committed to developing maritime business, technology, and practices that promote a sustainable future, contributing to economic growth, ecological health, and thriving communities. Washington State's maritime sector is uniquely poised to become a global leader in innovation and sustainability, ensuring that the region's maritime industry thrives.

With diverse membership encompassing local, and often national, and international stakeholders, cluster organizations exemplify the collaborative spirit necessary for successful climate action. By harnessing extensive networks throughout the region, these entities are well-equipped to coordinate multi-partner programs and collaboratives, forge strategic partnerships, disseminate crucial information, and catalyze sector innovation and sustainability through knowledge sharing, technology, business, and workforce development projects.

## Conclusion

Looking toward a decarbonized future in the PNW, the workshop was an excellent first step to bring ocean action stakeholders together and illuminate a path for the PNW to overcome challenges and harness the oceans' immense climate solution potential. OCAP serves not only as a guide to overcome challenges in ocean climate action, but also can guide regions through the opportunities that lie ahead.

There are challenges to overcome in green shipping, ocean renewable energy, mCDR, and nature-based solutions. As a network of ocean action professionals, overcoming these challenges will only succeed if we work together. Incorporating the recommendations that emerged throughout this workshop is an excellent first step to accomplishing the goal of a decarbonized future.

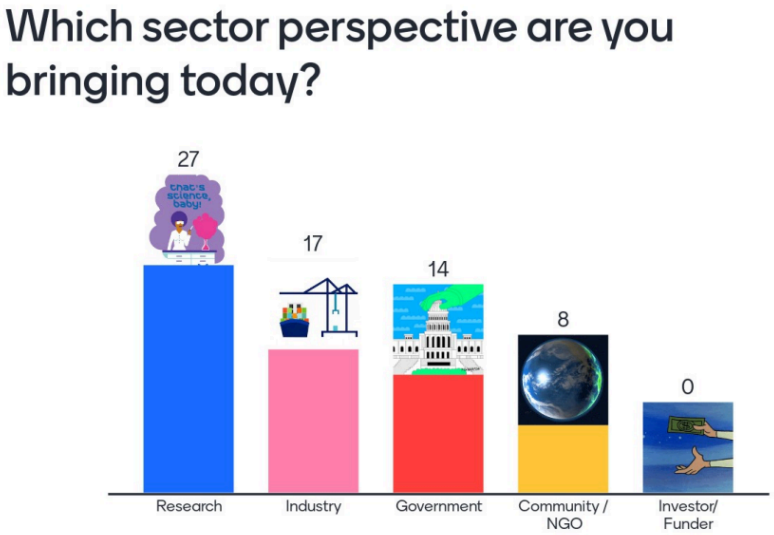
As the region's Blue Economy cluster organization, Washington Maritime Blue, is deeply committed to continuing to provide impartial and inclusive spaces, like this workshop, to drive the region towards achieving OCAP goals, fostering collaboration, and facilitating collective action among stakeholders across the PNW, driving progress toward a decarbonized future and sustainable ocean economy.

The PNW is not merely a region but a dynamic force capable of leading the nation toward a greener, more sustainable future. The result of the workshop was a call to action for stakeholders, communities, and industries to unite, collaborate, and drive change. This call to action should inspire collective efforts to ensure a thriving, resilient, decarbonized Pacific Northwest and, by extension, a brighter future for us all.

## Appendix 1

At the *Putting the 'Action' in the Ocean Climate Action Plan* workshop the audience was polled to gain a greater understanding from those who are working to achieve ocean climate action here in the PNW. Shown below are graphics that were produced from the results of some key polls.

**Question 1:**

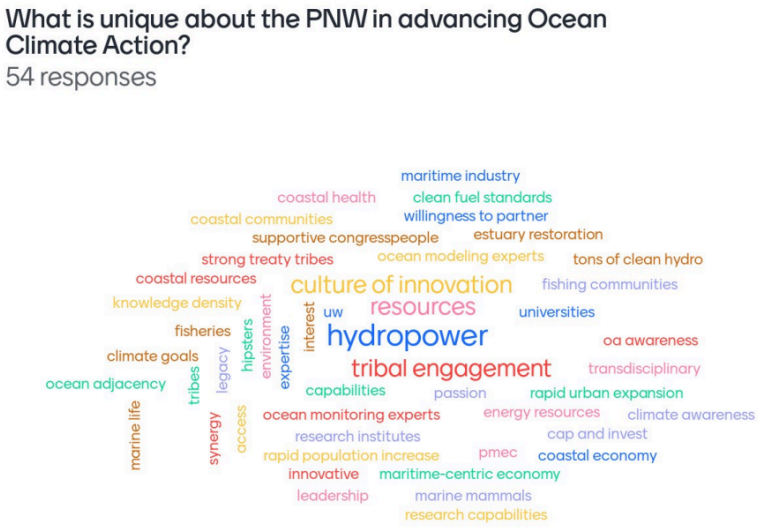



Workshop attendees were from multiple sectors that are priortizing ocean climate action including research institutions (27), private industry (17), government (14), and non-governmental orgnizations (8). Investors and funders were one sector that was not reperesented at the workshop, however, in the future their representives attendance will be a priority to ensure their perspectives are included in these discussions.

**Question 2:**

The word cloud above was produced by asking the audience what challenge they viewed as common between all three panel topics. A few of the most common responses include; Supply Chain, Permitting, Workforce, and Funding. While not all of these challenges were directly called out in each section of the paper, they are all key components to the mentioned challenges and are important to address in order to achieve solutions.

**Question 3:**




The word cloud above shows the audiences' perspective on what makes the PNW uniquely qualified to advance Ocean Climate Action. The PNW has a unique makeup of resources, industries, research facilities, and communities that can work togeather to achieve ocean climate action. Coming together to utilize each other's strengths, the PNW can lead the nation to meet our goals.

**Question 4:**


The workshop audience provided their perspectives on the state of collaborations in the ocean climate action space. The audience agreed that collaborations are occuring. However, this poll showed some collaboration mechanisms are not working as well as others, these include - B2B and B2G connections, co-opetion, and larger conferences focused on specific topic areas.

## References


BOEM. (2023). *California Activities*. Retrieved from Bureau of Ocean Energy Management: https://www.boem.gov/renewable-energy/state-activities/california

BOEM. (2023). *Oregon Activities*. Retrieved from Bureau of Ocean Energy Management.

California Energy Commission . (2022, 8 10). *CEC Adopts Historic California Offshore Wind Goals, Enough to Power Upwards of 25 Million Homes*. Retrieved from CA.gov: https://www.energy.ca.gov/news/2022-08/cec-adopts-historic-california-offshore-wind-goals-enough-power-upwards-25

ICCT. (2017). *Greenhouse Gas Emissions*.

ICCT. (2023). *Maritime Shipping*. Retrieved from The International Council on Clean Transportation: https://theicct.org/sector/maritime-shipping/

IPCC. (2022). *Summary for Policy Makers.* Cambridge, UK and New York, NY, USA: Cambridge University Press.

Kilcher, L., Fogarty, M., & Lawson, M. (2021). *Marine Energy in the United States: An Overview of Opportunities.* Golden, CO: National Renewable Energy Laboratory.

Lopez, A., Green, R., Williams, T., Lantz, E., Buster, G., & Roberts, B. (2022). *Offshore Wind Energy Technical Potential for the Contiguous United States.* Retrieved from NREL: https://www.nrel.gov/docs/fy22osti/83650.pdf

Oregon.gov. (2023). *Floating Offshore Wind Study: Benefits & Challenges for Oregon*. Retrieved from Oregon.gov: https://www.oregon.gov/energy/energy-oregon/Pages/fosw.aspx

The White House. (2022). *Biden-Harris Administration Announces New Actions to Expand U.S. Offshore Wind Energy.*

The White House. (2023). *Building a Clean Energy Economy: A Guidebook to the Inflation Reduction Act's Investments in Clean Energy and Cliamte Action.* Washington D.C.

Wendel, J. (2023, August 21). New Technology Removes Acid from the Ocean to Sequester Carbon. WA, USA.

Williams, R., & Feng, Z. (2023). *Global Offshore Wind Report 2023.* Global Wind Energy Council.