NCCOS
NATIONAL CENTERS FOR COASTAL OCEAN SCIENCE

BOEM
BUREAU OF OCEAN ENERGY MANAGEMENT

MAPPING THE WAY FORWARD: SPATIAL DATA INVENTORY AND INSIGHTS FOR MARINE PLANNING IN GUAM

Hagåtña, Guam
September 12th & 13th, 2024
WORKSHOP SUMMARY

Mapping the Way Forward: Spatial Data Inventory and Insights for Marine Planning in Guam

Hagåtña, Guam Workshop Summary
September 12 - 13, 2024
The Guam Museum

NOAA NOS NCCOS Technical Memorandum 353

This workshop was co-led by the NOAA National Centers for Coastal Ocean Science, Marine Spatial Ecology Division, and the Bureau of Ocean Energy Management.

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Acknowledgments:
The Workshop Planning team would like to honor the memory of Dr. Jason Biggs, who sadly passed away this winter. Through his research, and as the Assistant Chief of the Division of Aquatic & Wildlife Resources at the Guam Department of Agriculture, Jason made invaluable contributions to science and his community. His work and dedication will continue to inspire those who follow in his footsteps. We are grateful for our time spent with Jason during the workshop and for the knowledge that he shared with us. We extend our heartfelt condolences to his family, colleagues, and friends. He will be deeply missed.

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EXECUTIVE SUMMARY

Workshop Overview

The National Oceanic and Atmospheric Administration (NOAA) National Centers for Coastal Ocean Science (NCCOS), in partnership with the Bureau of Ocean Energy Management (BOEM), convened a multi-day marine spatial planning workshop in the U.S. territory of Guam on September 12th and 13th, 2024 (89 FR 73075). The workshop occurred in the days immediately following the inaugural meeting of the recently formed BOEM Guam Intergovernmental Renewable Energy Task Force (hereafter, Guam Task Force). This technical memorandum summarizes the outputs of this workshop.

NCCOS and BOEM are working to build marine spatial planning capacity in the Pacific region to inform potential leasing and planning of offshore wind energy (OSW) in Guam. Additionally, marine spatial planning, especially for island communities like Guam and the Northern Marianas, holds great promise to assist coastal managers, indigenous groups, environmental organizations, and industry with planning for future development of the blue economy. The following goals guided the workshop:

- Learn more about NOAA's marine spatial planning approaches and BOEM's offshore wind planning process
- Inventory available spatial data for Guam and the Commonwealth of the Northern Mariana Islands (CNMI)
- Document the best available data and known data gaps
- Increase local capacity and resources for regional ocean spatial planning
- Further develop an engaged community to inform future marine planning efforts

Workshop Organizers and Participants

NCCOS and BOEM coordinated closely by forming a steering committee to develop the workshop agenda. Committee membership included marine planners, geographic information system (GIS) experts, renewable energy specialists and, and times, senior management staff from each agency. A facilitation team lent planning support to the steering committee and ensured broad participation at the workshop for both in-person and virtual participants. The NCCOS Marine Planning Coordinator for the Pacific region, Jessica Carlton, provided overall workshop coordination and will follow up on identified data leads.

Nearly 45 individuals attended the Guam workshop. Participants included a broad cross-section of data expertise from local resource management and environmental protection agencies, the Guam Power Authority (GPA), and various science initiatives (e.g., coral reef monitoring, statistics plans and programs, biosecurity). Representatives from the federal government consisted of GIS specialists, marine ecologists, Department of Defense (DOD) representatives, and other data experts from the Pacific Region offices of NOAA, BOEM and the United States Geological Survey (USGS).

Workshop Outcomes

The workshop produced a wide range of available data sets and leads across each ocean sector explored. Several gaps were also identified, generally for every sector. Participants acknowledged where abundant data exists, however, many stressed the need to acquire better and more up-to-date information, particularly for the *Natural and Cultural Resources*, *Metocean and Other*, and *Industries* sectors. Data development work for *Offshore Wind* has just begun in Guam, but will build on data gathering efforts already undertaken in other regions of the U.S. In addition, BOEM is partnering with the National Renewable Energy Laboratory (NREL) to better understand the wind resource offshore Guam and the Levelized Cost of Energy (LCOE) associated with OSW development in the region.

At various times during the workshop, attendees noted gaps in attendance, possibly the result of a typhoon warning for Guam during the week of the event. Participants identified several local agencies, organizations and individuals that can provide valuable assistance to the data development work. As with similar workshops held in different regions of the U.S., DOD personnel attended and provided assistance in discussing *National Security* issues and the publicly available data for this sector. A common takeaway at the conclusion of the event was that more local agencies and organizations need to be engaged in the planning process for the spatial analysis to comprehensively and effectively inform the prospect that OSW may hold for the island of Guam.

This summary of workshop outcomes charts a path for increased coordination on marine spatial data between the federal government and its territorial partners in Guam in the months and years ahead. Detailed outcomes for each ocean sector—including additional available data, the leads to acquire this information, and data gaps—are described below. The narrative text of this report has been kept in the conversational style of dialogue that occurred at the workshop. Given the nature of brainstorming across multiple topics, some repetition, both within and across ocean sectors, is expected.

WELCOME AND OPENING REMARKS

John Cruz, GPA's Assistant General Manager, welcomed all workshop participants and kicked off opening remarks. He emphasized that the launch of the BOEM's Guam Task Force, combined with this multi-day data development workshop, presents a great opportunity for the people and environment of Guam. In reflecting on the island's legacy, he sang a short Chamorro song, then asserted, "*we must endear, remember and make proud what comes before us*." This workshop, he noted, is focused on the important task of gathering a wealth of data to inform offshore wind planning and also serve other uses. John thanked NOAA and BOEM for the material support needed to conduct this workshop, and encouraged constructive engagement between local and federal data experts and the Guam community.

Doug Boren, Pacific Regional Director for BOEM, highlighted the inaugural meeting of the Guam Task Force, held just the day prior. BOEM's mission is to manage the development of U.S. Outer Continental Shelf (OCS) energy, mineral, and geological resources in an environmentally and economically responsible way. Doug thanked everyone for participating in the data development workshop, then briefly described BOEM's planning and decision-making process for any OSW that is proposed in federal waters of the U.S. and its territories. He noted how BOEM's partnership with NCCOS has come to fruition in multiple regions across the nation, including in the Pacific, as the two agencies continue to work together. It is important, he concluded, to begin collecting data in Guam at this early stage, as more and better information informs planning and can make agency decision-making easier.

James Morris, Ph.D., Marine Spatial Planning Team Lead with NOAA's NCCOS, expressed his appreciation for the group, then briefly described how NCCOS has partnered with BOEM to help inform the selection for Wind Energy Areas (WEA) on the OCS around the nation. NCCOS acquires best available science, then develops spatial suitability models collaboratively with BOEM to inform siting of wind energy. Dr. Morris acknowledged the uniqueness of Guam, the expertise held by locals, and the early stage of work as the island considers wind as a potential source of energy to meet its ambitious renewable energy goals. This particular workshop, he noted, comes at a critical moment when NCCOS and all groups involved will work together to build the ocean intelligence needed to make informed decisions. Dr. Morris thanked everyone for their engagement and commitment to this work and concurred with Mr. Cruz regarding the opportunity for important collaboration ahead.

APPROACH TO WORKSHOP COLLABORATION

Facilitator Rich Wilson reviewed the workshop goals, agenda and proposed approach to maximize data brainstorming, idea generation and contributions among all participants. The five ocean sectors which served to focus group discussion included:

1. ***Natural and Cultural Resources*:** information about protected species/areas, sensitive habitats, cultural uses of the environment, social resources, historical and archaeological sites
2. ***Metocean and Other*:** meteorological and oceanographic data, geological features and seafloor substrate, water depth, slope, boundaries
3. ***National Security*:** locations of various military and associated operation areas
4. ***Industries*:** shipping lanes, subsea cables, weather events and forecasting, tourism, areas for commercial and recreational fisheries, fishery management areas, fishery independent surveys
5. ***Offshore Wind*:** data relevant to siting offshore wind, distance from shore/ports, wind speed

Following the welcoming remarks, Dr. Morris shared additional information about NOAA's approach to marine spatial planning to set the stage for the data development task ahead for the group. Deanna Meier, Renewable Energy Specialist with BOEM, followed with an overview of BOEM's planning process, a summary of where the process is at in Guam, and next steps. For the remainder of the workshop, various data specialists with NCCOS and BOEM, along with DOD personnel, helped frame data development conversations by presenting baseline information collected to date for each ocean sector. These specialists included:

- Jessica Carlton, NCCOS Marine Planning Coordinator, shared data for the *Natural and Cultural Resources* and *National Security* sectors.
- Steve Sample, Executive Director of the Military Aviation and Installation Assurance Siting Clearinghouse, DOD, along with his colleague Nathan Owens, provided additional context and data related to the *National Security* sector.
- Eliza Carter, NCCOS Marine GIS Analyst, shared data for the *Metocean and Other* sector.
- Rockne Rudolph, BOEM GIS Specialist, reviewed a webmapper tool at the outset that participants could use during small group discussion to explore different data layers. Rockne also shared data for the *Industries* sector.
- Frank Pendleton, BOEM GIS Specialist, shared examples, at both the outset and during the *Offshore Wind Energy* session, of GIS data from other regions that to date has informed OSW planning efforts. He explained how this work already conducted in other regions will inform and support data gathering efforts in Guam.

Throughout the workshop, the facilitation team utilized three prompting questions, with related follow-ups, to stimulate group discussion of each ocean sector:

1. What are the positive attributes of the data just presented? Conversely, what are the issues or challenges associated with these data?
2. Are you aware of any data that are missing from the list but available? If so, can you provide a lead to acquire these data?
3. What gaps exist for each data layer topic?

Following the presentation of data layers for each ocean sector, every individual participant used a worksheet to silently generate ideas prior to engaging others in small, then large group discussion. The facilitation team encouraged participants to be concise and share the air when working in small groups, stay focused on marine spatial data, and be sure to introduce themselves, including one's professional background, when sharing ideas with the full group. Additional facilitation support enabled a similar process for online participants.

For the final session on *Offshore Wind Energy*, BOEM's Frank Pendleton shared a pre-recorded video presentation by Walt Musial, NREL's Chief Engineer for Offshore Wind. Walt outlined the methodology that NREL uses to model the costs of OSW. Frank then utilized his own slides to describe data that is relevant to siting offshore WEAs, lease areas, and transmission cables. Group discussion following this combined presentation focused on the economic costs of wind energy production, validation of the NREL model, and questions around whether potential connection points on land in Guam are part of the analysis.

As the workshop concluded, participants shared key takeaways (page 31 below) from a day-and-a-half of work together, along with any emerging insights to support marine spatial planning in Guam. NOAA's Dr. Morris and Jessica Carlton brought the event to a close by previewing anticipated next steps ahead for the data development work.

SITING OFFSHORE WIND

NOAA's NCCOS supports BOEM's efforts to facilitate the responsible development of renewable energy on the OCS of the United States and its territories. Specifically, NCCOS provides data development and suitability modeling to inform BOEM's offshore wind lease planning efforts through an interagency agreement. All of this work between the two agencies supports the Biden-Harris administration's goal of deploying 30 gigawatts of offshore wind energy by 2030 and 15 GW of floating offshore wind energy by 2035.

Under BOEM's current regulatory framework (as of June 2024), there are approximately 40 leases/planning areas for OSW along the coastline of the US and its territories. The geographic scope under consideration at this workshop covers federal waters off the coast of Guam. This report adds to a series of NOAA NCCOS Technical Memoranda which report the outcomes of similar marine spatial data development workshops held for the U.S. Virgin Islands, Puerto Rico, and the southeast Atlantic region including Virginia, North Carolina and South Carolina.

NOAA's Marine Spatial Planning Process

At the beginning of his presentation, Dr. Morris shared a short educational video which NCCOS produced with BOEM. The video describes that the U.S. is committed to developing safe, reliable offshore renewable energy to power homes and businesses, provide good paying jobs and support a thriving economy. The video also details the important role that spatial planning plays in assisting BOEM to identify where there are the fewest user and environmental conflicts and the highest potential for OSW.

After the video, Dr. Morris described NOAA's OSW mission and explained how marine spatial planning is a process which brings together multiple ocean users—including industries, government, conservation, indigenous communities, and recreational sectors—to make informed and coordinated decisions about how to sustainably use natural resources, including in territories like Guam. NCCOS uses marine planning science to support the needs of coastal communities to balance tradeoffs between sustainable use and conservation of marine resources.

NCCOS has developed a robust marine spatial planning framework over the last decade. Over 75 spatial analyses have been completed to date, including two published regional scale atlases which compile best available science to inform the identification of Aquaculture Opportunity Areas (AOAs) in the Gulf of Mexico and Southern California Bight. A third atlas will soon be developed to help identify AOAs in Alaska state waters. These established methods provide the foundation for interagency coordination now occurring between NOAA and BOEM as wind energy projects are increasingly proposed in federal waters across the U.S.

NOAA and BOEM collaborate with local partners in all regions of the U.S. to advance marine spatial planning. Dr. Morris described how the early stage of work in Guam necessitates collaboration among data experts, particularly those with extensive local knowledge, in order to foster an inclusive process to build ocean intelligence. As data come together, NCCOS develops spatial suitability models which generate heat maps that allow planners and coastal managers to:

- Analyze the whole ecosystem through defensible and transparent methods
- Identify both hotspots of conflict as well as areas of opportunity
- Conduct scenario planning and support comprehensive environmental review

Dr. Morris emphasized that marine spatial planning is about improving ocean intelligence and digital infrastructure. Engagement with local subject matter experts—building, for example, on the knowledge and data already possessed by many individuals, organizations, and agencies in Guam—is a key element of the process. In time, a spatial suitability analysis provides a holistic view across multiple ocean sectors.

As Dr. Morris concluded, he fielded questions and, with support from BOEM's Doug Boren, the two further clarified how the spatial suitability model is developed, explained the search for OSW leasing areas, and, though no proposed project has been put forward, described the anticipated process ahead to plan for OSW development in Guam.

BOEM's Siting Process

Deanna Meier, Renewable Energy Specialist, BOEM, followed Dr. Morris with a high-level presentation on BOEM's planning process as it relates to the siting, permitting and oversight of OSW in U.S. federal waters. BOEM, Deanna noted at the outset, welcomes engagement throughout the process with indigenous communities, government agencies and interested stakeholders. Frank Pendleton described the kind of data needed to inform decision-making, and Rockne Rudolph demonstrated how a webmapper tool can be utilized during small group discussion at the workshop.

BOEM manages almost 3.2 billion acres of the US OCS and is one of the 11 Bureaus of the U.S. Department of Interior. In the Pacific Region, BOEM's jurisdiction generally extends from three to 200 nautical miles off the coasts of California, Oregon, Washington, Hawaii and the Pacific Territories. National Marine Sanctuaries, Marine National Monuments, National Wildlife Refuges, and National Parks are excluded from BOEM's jurisdiction.

Deanna utilized a graphic to illustrate BOEM's competitive renewable energy leasing process and associated timeline. She described a long process that includes four phases:

- *Planning and Analysis*: BOEM typically establishes an Intergovernmental Renewable Energy Task Force, publishes a Call for Information and Nominations, identifies Wind Energy Areas, and conducts environmental reviews of lease and grant issuance and site assessment activities. This phase typically takes 1-2 years.
- *Leasing*: This phase includes the publication of proposed and final leasing notices, conducting an auction, and lease issuance. This phase can typically take up to a year.
- *Site Assessment*: This phase consists of lessee site characterization activities, such as surveying the Lease Area, and can take up to five years.
- *Construction, Operations and Decommissioning*: This phase includes lessee submission to BOEM of a Construction and Operations Plan for environmental and technical reviews, and submission of a Facility Design Report and Fabrication and Installation Report to the Bureau of Safety and Environmental Enforcement (BSEE) before construction may begin.

Given some clarification questions put forward by workshop participants, Deanna reminded the group that Guam is currently at the earliest stage of the planning process. As described above, BOEM, at the request of the Governor of Guam, formed and brought together the Guam Task Force for its inaugural meeting earlier in the week. In her final slides, Deanna shared information about floating offshore wind technology. This is an emerging sector, she noted, and projects unfolding in different regions of the nation and around the world will likely serve as models for future efforts with this technology.

At the conclusion of their joint presentation, Dr. Morris and Deanna, with at times support from BOEM's Doug Boren and Necy Sumait, fielded a range of questions about long-term OSW plans for Guam, who can acquire a lease, the ability for smaller energy production companies to navigate the process, and whether or not a lease for renewable energy could also apply to other ocean extraction or use industries. Doug addressed the questions with known answers, but pointed out that, given the early stage of work and that no projects have yet been proposed, the answers to some questions are not yet known or well defined.

Workshop participants and interested parties may access the workshop framing presentations and data layer maps shared by NOAA and BOEM here.

DATA DEVELOPMENT ACROSS OCEAN SECTORS

Throughout the course of the workshop, participants would, after the presentation of known data for each ocean sector, work in small groups to identify missing but available data not included in the presentation, leads to acquire said data, and data gaps. In addition, each small breakout discussed positive attributes of the shared data, and, conversely, identified any issues or challenges. Subsequent discussion as a full group spurred additional information sharing, insights, and further engagement around the initial ideas discussed in small breakouts.

As seen in the workshop attendee table in Appendix C, participation included several federal agencies and a broad cross-section of data expertise from local resource management and environmental protection agencies, the Guam Power Authority, and various science initiatives. That said, at various times during the workshop, attendees noted gaps in attendance, possibly the result of a typhoon warning for Guam during the week of the event. Attendees identified several local agencies, organizations and individuals who were not present, yet could provide valuable assistance to the data development work. Looking towards future engagement beyond the workshop, locally-based attendees offered to help staff at NOAA and BOEM to connect with, among others, the following groups:

- Guam Water Works Authority (GWA)
- Port Authority of Guam
- National Park Service (NPS)
- BOEM Coastal Zone Management Program
- Water Research Energy Institute
    - Mina Cane
    - John Jenson
- State Historic Preservation Office
- University of Guam (UOG)
- Guam Environmental Protection Agency (EPA) – Environmental Monitoring and Analytics Services
- UOG – Center for Island Sustainability
- CNMI – Commonwealth Utilities Corporation, Office of Planning and Development
- Staff of the Natural Resources Committee of the Legislation of Guam
- Maritime industry and ports professionals
- Guam Chamber of Commerce
- Guam Public Utilities Commission and associated telecommunications agencies
- Guam Economic Council

Overall data development outcomes for each session are summarized below. Only minor edits to improve readability and consistency of presentation have been made to the ideas captured either on participant worksheets or via chart writing during full group dialogue. Given the nature of brainstorming across multiple topics, some repetition of text both within and across ocean sectors is expected. The tables and associated bullets below reflect information collected in small groups for the sector under consideration, then subsequently discussed in a full group setting.

The NCCOS database presented for each ocean sector can be viewed here.

Session 1

NATURAL AND CULTURAL RESOURCES

Jessica Carlton, Marine Planning Coordinator with NCCOS (Affiliate), reviewed available data for the *Natural and Cultural Resources* sector. This sector includes information about protected species/areas, sensitive habitats, cultural uses of the environment, social resources, and historical and archaeological sites. NCCOS presented 48 data layers for this sector, including:

- Historical infrastructure
- Marine monitoring sites
- Marine protected areas
- Opportunity zones
- CNMI beach monitoring sites
- Federal Emergency Management Agency (FEMA) flood zones
- Population data
- Recreation
- Wastewater treatment
- Community Infrastructure
- Habitat data
    - Seagrass
    - Saltmarsh
    - Mangrove
    - Tidal flat
    - Benthic
    - Habitat Areas of Particular Concern (HAPC)
    - Critical habitat
    - Essential Fish Habitat (EFH)
    - Fish havens
- Species data
    - Corals and sponges
    - Coral resilience
    - Shallow coral mapping
    - Seabird tracking data
    - Cetacean surveys

In addition to the participant outputs described below, two maritime archaeologists, Madeline Roth and Dr. Jennifer McKinnon, submitted public comment regarding suggestions for considering maritime heritage in Guam. Among other suggestions, they recommend NOAA work with BOEM, local agencies/organizations, and other Federal offices to access tangible heritage resources such as historic watercraft, vessels and aircraft that could be affected by OSW development. They also recommend that NOAA should invest in trust building with cultural practitioners before seeking information from this group, take steps to protect any information acquired, and ensure a reciprocal relationship. The full public comment letter can be accessed here.

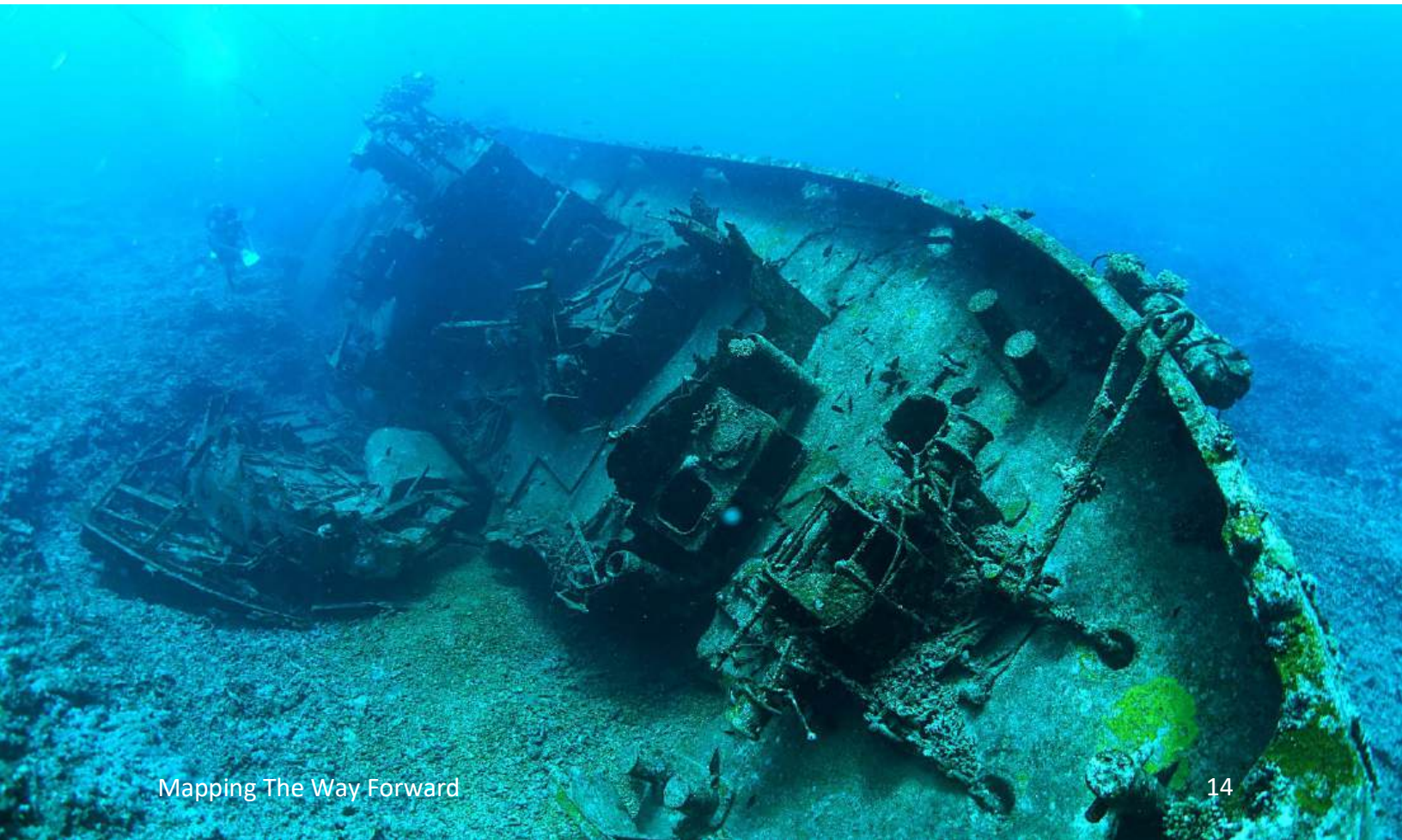
Positive attributes of data presented for the *Natural and Cultural Resources* sector:

- There are numerous different uses for the data.
- Abundant data are available across several of the subtopics reviewed.
- There is a good variety of data resources.

Issues or challenges with data presented for the *Natural and Cultural Resources* sector:

Data Quality and Significance

- The various data layers differ in their level of significance.
- Overlapping data sets may contradict one another.
- Quality issues within the data layers will likely compound when the layers are squeezed/re-estimated within the 10-acre polygons.
- In some instances, multiple data sources are available for the same type of data. These sources may not align. In such an instance, how will NCCOS determine which data source to use in the model?
- Global data sets and large-scale data sets, such as data from the United Nations Environment Programme (UNEP), are coarse and should be validated for the region.
- Many data sources are based on national or global modeling tools, which could be problematic or inaccurate.
- The coral mapping prioritization layer seems irrelevant.
- It is important to determine which NOAA data comes from which line office.



Outdated and Incomplete Data

- Some of the presented data sets are outdated (e.g., human population).
- More localized data is necessary.
- Limited data exists offshore beyond the 3 nautical mile line.
- EFH data sets need to be updated.
- Fish haven data layers may be incomplete – suggest engaging fishermen to properly identify these important areas.
- Most National Marine Fisheries Service (NMFS) protected species survey data is incomplete.
- More human use data is needed.
- Guam is a multi-cultural community. It may be challenging to identify which cultures to collect data from that are relevant to this effort.
- Will CNMI data be incorporated in this effort?

Natural and Environmental Data

- Temporal events have altered the landscape, rendering some natural resources data sets irrelevant. For example, the 2013–2017 severe coral bleaching event significantly transformed the marine environment. More recent typhoons also impacted habitat and other data layers.
- Any data that excludes benthic information from the summer of 2018 or later will have missed the Guam/CNMI major bleaching event, likely overestimating coral percentage and failing to capture locations that have now proven to be important resilience sites.
- The only designated EFH and HAPC are for bottom fish and pelagic management unit species by depth ranges.
- Seagrass habitat data layers appear too expansive – suggest check for accuracy.
- Bird data may be unavailable for the most important species.
- Benthic data appears to be minimal below 100 feet, creating a large gap at depths that are still known to have vibrant reefs.
- Benthic habitat information is weak at the outer banks.

Table 1. Available data and leads for the *Natural and Cultural Resources* sector

Available Data	Lead(s) to Acquire
Marine and Coastal Habitat Data	
Nearshore reefs	• UOG Marine Laboratory • NOAA National Centers for Environmental Information (NCEI)
Coral habitat and coral monitoring	• 2022 National Coral Reef Monitoring Program (NCRMP) data • 2022 Office of Coast Survey (NOAA OCS) Rainier Integrates Charting, Hydrography, and Reef Demographics (RICHARD) Cruise • Guam Department of Agriculture (DOAG), Division of Aquatic and Wildlife Resources (DAWR) • UOG Marine Laboratory
Coral and fish species distribution	• UOG Marine Laboratory • NCEI
Coral reef nurseries	• Ashton Williams, Guam Department of Agriculture Coral Reef Initiative (DOAG-CRI)
Shallow benthic habitat reef data	• NOAA Coral Reef Information System (CoRIS)
Deepwater benthic habitat data	• dbSEABED and with INSTAAR as lead partner • Eric Cruz, NMFS
Critical seafloor habitat	• NMFS
Benthic data	• Tom Schills, Ph.D., UOG • Ed Sweeney, NCCOS • NCRMP • NCEI Accession 0274016
Habitat maps that include Apra Harbor and the Haputo Ecological Reserve Area (ERA)	• Ed Sweeny or Bryan Costa, NCCOS
Seagrass habitat	• Pacific Islands Ocean Observing System (PacIOOS) • US Army Corps of Engineers (USACE) • US Navy
Mangrove habitat	• USACE • US Navy
EFH data (updated)	• NMFS Pacific Islands Regional Office (PIRO) Habitat Conservation Division (HCD) • Chuck Wheeler, Becky Walker and Joey Lecky, NMFS
HAPC data (updated)	• Chuck Wheeler, Becky Walker and Joey Lecky, NMFS

Table 1. *Continued*

Available Data	Lead(s) to Acquire
Marine and Coastal Habitat Data *(Continued)*	
Reef restoration locations	• Laurie Raymundo, Ph.D., UOG Marine Laboratory
CNMI reef resiliency data	• Link 1 • Link 2 • Link 3 • Link 4
Guam long-term reef monitoring program data	• David Burdik, Ph.D., UOG Marine Laboratory
Critical habitat areas for fishery species	• None provided
Seamount habitat	• Yesson et al., 2022 • Scripps Institute of Oceanography 2023 data
Wildlife and Ecological Data	
Migratory shorebird data	• eBird • Pacific Marine Assessment Program for Protected Species (PacMAPPS)
Ecological and biological data	• Naval Facilities Engineering Systems Command (NAVFAC) • US Navy Marianas Islands Range Complex (MIRC) • Peter Houk, Ph.D., UOG
Sea turtle survey data	• US Navy MIRC • NOAA Marine Turtle Biology and Assessment Program (MTBAP) • NMFS Pacific Islands Fisheries Science Center (PIFSC)
Sea turtle nesting data	• Tom Shells, Ph.D., UOG • United States Fish and Wildlife Service (USFWS)
Marine mammal densities	• None provided
Movement patterns of highly migratory species	• None provided
Whale monitoring data	• US Navy
Other ocean species survey data	• DOD contractors
Island sources and destination of virtual larvae for the Mariana region, simulation results (2004 to 2012)	• NCCOS Assessment (NCEI Accession 0156648)
Ichthyoplankton survey data	• None provided

Table 1. *Continued*

Available Data	Lead(s) to Acquire
Cultural and Historical Data	
Historic and culturally significant sites	• CHamorru Land Trust Commission (CLTC) • Guam Department of Parks and Recreation (DPR) • Guam Historic Preservation Office (HPO) • Patrick Lujan, Guam State Archeology Office • Judy Amesbury, Micronesian Archaeological Research Service • NPS • SHPO
Submerged cultural landforms	• None provided
WWII shipwreck data	• None provided
Sherman tanks	• CNMI Historic Preservation Office
Recreational and Human Use Data	
Dive sites (recreational)	• Guam Visitors Bureau
Dive sites (marine monitoring)	• CNMI Division of Coastal Resources Management (DCRM) • CNMI Division of Fish and Wildlife (DFW)
Beach access and popular beach locations	• Guam Visitors Bureau • Marianas Divers Association
Recreational boating	• Guam police department
2020 population data	• United States Census
Environmental and Pollution Data	
Municipal water sources	• None provided
Powerplant seawater discharge locations	• None provided
River outfalls and runoff	• Guam EPA
Other Natural and Cultural Resources Data Sources	
CNMI data sets	• CNMI Bureau of Environmental and Coastal Quality (BECQ) public permitting application (dcrm.gov.mp)
Applicable data	• Resource Assessment Investigation of the Mariana Archipelago
Applicable data	• RICHARD Cruise (2022) • Sette cruises (2010, 2014, 2015, 2018)
Applicable data	• UOG Tech Reports Biological Database
Applicable data	• Guam Bureau of Statistics and Plans – Coastal Management Program (BSP CMP)
Applicable data	• DOAG
Applicable data	• Guam Department of CHamoru Affairs
Applicable data	• Guam EPA

Table 1. *Continued*

Available Data	Lead(s) to Acquire
Other Natural and Cultural Resources Data Sources *(Continued)*	
Applicable data	• NOAA NCCOS Seascape Ecology and Analytics
Applicable data	• Smithsonian National Postal Museum
Applicable data	• United States Department of Agriculture (USDA)
Applicable data	• Matthew Santos, Guam BSP
Applicable data	• Romina King, Ph.D., UOG
Applicable data	• Yuming Wen, Ph.D., UOG
Applicable data	• Tye Kindinger, Ph.D. or Andrew Gray, NMFS AFSC

Data gaps for the *Natural and Cultural Resources* sector:

- Deepsea coral habitat
- Deepwater benthic or sensitive habitats
- Pelagic data
- Pelagic fish migratory patterns
- Sea turtle migration data
- Sea turtle nesting sites
- Marine mammal data
- Distributions of birds, cetaceans, fish, marine mammals
- Bird distribution data (migratory and shorebird)
- Biologically important areas
- Offshore cultural areas
- Indigenous fishing and cultural areas
- Traditional Ecological Knowledge
- Locations of submerged cultural landforms
- Locations of seafaring activities
- Localized data sets
- Historical war data

Session 2:

METOCEAN AND OTHER

Eliza Carter, Marine GIS Analyst with NCCOS (Affiliate), provided an overview of data layers categorized in the *Metocean and Other* sector. This sector includes data layers related to meteorological and oceanographic data, geological features and seafloor substrate, water depth, slope, and boundaries. Eliza presented 27 data layers for this sector, including data related to:

- Boundaries
- Bathymetry
- Rivers and streams
- Tropical cyclones
- Geohazards
- Tsunamis
- Geologic features
- Wind
- Coastal Resilience Evaluation and Siting Tool (CREST) Indices

Positive attributes of data presented for the *Metocean and Other* sector:

- A significant amount of high-resolution data exists for this sector.
- Much of this data can support resiliency planning.
- The earthquake and cyclone data has good spatial and temporal resolution.
- A unified bathymetric product exists for the region.
- The data compilation effort included earthquake, typhoon, and tsunami data.
- Comprehensive boundary data is available.

Issues or challenges with data presented for the *Metocean and Other* sector:

- Bathymetry may be incomplete and outdated.
- Bathymetry data is limited in depth and coverage.
- Bathymetry at 5-meter resolution contains gaps.
- Bathymetry data has limited coverage beyond 1,300 mean water depth
- More high-resolution bathymetry data is necessary.
- Better contour data is needed.
- More data points are needed for the resiliency hubs layer.
- Tropical storm segment data is outdated.
- More recent typhoon data is needed.
- The temporal resolution map for Tropical Cyclone Storm Segments from 1988-2022 is missing many storms that passed through the Marianas.
- Storm data should include 2023 data sets.

Table 2. Available data and leads for the Metocean and Other sector

Available Data	Lead(s) to Acquire
Seismic and Geological Data	
Earthquake simulation data	• Lawrence Livermore National Laboratory
Earthquake impact radius	• Earthquake eTrack • USGS
Faults and seismic risk hazard maps	• None provided
Tsunami data	• None provided
Backscatter data	• PacIOOS • RICHARD Survey • NOAA Pacific Islands Benthic Habitat Mapping Center (PIBHMC)
Seafloor substrate and geological features	• Okeanos Explorer 2016 Deepwater Exploration of the Marianas cruise
Multibeam impact scatter data sets	• PIBHMC • 2022 RICHARD surveys • Scripps Institute of Oceanography, Daniel Rudnick, Ph.D.
Back-arc modeling	• Scripps Institute of Oceanography
GEBCO contours	• Rockne Rudolph, BOEM
Weather and Climate Data	
Tropical storm segment data	• FEMA maps • National Weather Service (NWS) at Tiyan
El Niño/La Niña weather patterns	• None provided
Windspeed data	• PacIOOS modeled wind data • NREL information coming soon • Weather research and forecasting (WRF) Model • National Centers for Environmental Prediction (NCEP) Model
Ocean fronts	• None provided
Typhoon data	• NWS
Projected sea level rise	• None provided
Wave run-up	• FEMA
Oceanographic and Bathymetric Data	
Ocean current data	• PacIOOS Regional Ocean Modeling System (ROMS) data • NCCOS (for 2016 data) • Planned high frequency radar (HF) sites for Anderson Air Force Base (AFB) and Pona Point on Rota
Tidal currents	• PacIOOS ROMS

Table 2. *Continued*

Available Data	Lead(s) to Acquire
Oceanographic and Bathymetric Data *(Continued)*	
Shoreline data	• NOAA Continually Updated Shoreline Product (CUSP) data set
State waters	• NOAA OCS
Lidar data	• UOG Drone Corps
Shallow Lidar 0-60 feet	• USGS
2019-2020 Lidar Topobathymetry for CNMI and Guam	• NOAA's National Geodetic Survey (NGS)
Bathymetry data	• 2022 RICHARD surveys • US Navy (Moffatt & Nichol) • NOAA NCEI • NOAA OCS • "Active Captain" Application
Contour data	• US Navy
Submerged lands	• CLTC
Marianas Trench Marine National Monument (MTMNM) boundaries	• NOAA Pilot Web Mapping Project link
Sea surface temperature	• NOAA Coral Reef Watch
Upwelling data	• None provided
Chlorophyll	• None provided
Salinity	• None provided
Argos buoy data	• Matt Kendall, NCCOS
Observing buoys	• PacIOOS Wave Buoys: ○ #121 IPAN, Guam ○ #196 Ritidian Point, Guam ○ #197 Tanapag, CNMI
Stream flows	• USGS
Other	
Typhoon shelters	• None provided
Marine contaminant and pollution runoff studies	• NCCOS
Localized river data	• UOG • Village mayors
Water quantity and quality	• Water and Environmental Research Institute of the Western Pacific (WERI) weri.uog.edu and guamhydrologicsurvey.uog.edu
Municipal water sources and wells	• None provided
Power resiliency maps	• Argonne National Laboratory, Dr. Tom Wall, twall@anl.gov

Table 2. *Continued*

Available Data	Lead(s) to Acquire
Other *(Continued)*	
Various data layers including: wells, ports, population density 202, contour, seismic faults, etc.	• Pacific Disaster Center (PDC) DisasterAWARE PRO product, Cassie Stelow
Applicable data	• GWA, Miguel Bordallo or Vangie Lujan
Applicable data	• Guam BSP CMP

Data gaps for the *Metocean and Other* sector:

- Seamount data between Guam and Rota
- Bathymetry at 5-meter resolution
- Bathymetry for the last 10 years
- Local river data
- Fault lines
- Emergency shelter locations
- Other energy data

Session 3

NATIONAL SECURITY

Jessica Carlton presented data layers for the *National Security* sector. She reviewed the 19 data layers available for the *National Security* sector including:

- Military operating areas
- Danger areas
- Danger zones
- Formerly used defense sites
- Obstructions

Immediately following Jessica's presentation, the facilitation team welcomed Steve Sample, Executive Director of the Military Aviation and Installation Assurance Siting Clearinghouse, DOD. Attending virtually, Steve was joined by his colleague Nathan Owen, who has provided data development assistance at previous marine spatial planning workshops.

Steve brought important context to the *National Security* session regarding how DOD participates in the marine spatial planning process, and specifically in the OSW discussion. He shared additional DOD data that is publicly available, described how coordination occurs with NOAA and BOEM, and reviewed the process by which DOD assesses potential level of impact of any proposed offshore wind facilities, as well as mitigation measures which can be taken. Steve and Nathan highlighted the following additional data and stressed its importance:

- Military training routes
- Danger areas
- High frequency radar
- Geographic training areas
- Navy concerns – what's going on above or below the surface
- Floating turbines – subsurface mooring infrastructure

Steve emphasized the DOD doesn't protect assets like a particular airspace, rather, it protects the mission. In addition to actively participating in the Guam Task Force and the data development work with NOAA, DOD will communicate any views of potential impacts directly with BOEM to inform offshore wind planning activities. Steve concluded by responding to a few questions and suggestions about finding balance to benefit all activities, links between energy security and national security, and ongoing coordination among agencies as OSW work unfolds in Guam.

Session 4

INDUSTRIES

Rockne Rudolph, GIS Specialist with the BOEM Pacific Region, reviewed data layers for the *Industries* sector. He shared information related to shipping lanes, subsea cables, weather forecasting, tourism, areas of both commercial and recreational fisheries, fishery management areas and fishery independent surveys. He presented 25 data layers organized under the below list of topics.

- Submarine cables
- Anchorages
- Ports, fairways, and navigational aids
- Environmental sensors and buoys
- Ocean disposal sites and Superfund sites
- Energy
- Vessel traffic
- Fishing activity
- Weather stations and radar

Positive attributes of data presented for the *Industries* sector:

- The presentation included a good variety of data.
- Reviewing fishing activity is interesting and helpful to the process.

Issues or challenges with data presented for the *Industries* sector:

- The submarine cable data contains some inaccuracies.
- Smaller cable landing sites on the east and southern ends of the island are not represented.
- New emerging industries may not yet appear in the data sets. This may include, for example, ocean thermal energy conversion, deep water ocean harvesting, marine hydrokinetic energy and aquaculture. The Guam Economic Council may be able to provide industry projections.
- Very few fisheries experts participated in this data workshop, leading to a lack of shared fisheries information.
- The spatial resolution of existing fisheries access data is coarse, and the survey methods have limitations.
- Automatic Identification System (AIS) data may be inaccurate.
- AIS is only required on vessels over 65 feet. Small vessel and local fishing information are missing from the data.
- Related to the above, Guam vessels within the exclusive economic zone (EEZ) typically do not use AIS as they are too small. NMFS and NCCOS will need to investigate throughout this process and determine the best way to spatially represent fishing effort, revenue, and importance.

Table 3. Available data and leads for the industries sector

Available Data	Lead(s) to Acquire
Energy and Infrastructure	
Updated powerline and power plant data	• GPA
Powerplant and powerline locations, including aging powerplant infrastructure	• GPA
Cooling intakes for powerplants	• None provided
Cable landing sites	• David Delaney or Sean Hanser, Joey Lecky, NMFS • USACE • Guam CMP Program • Public Utilities Commission
Smaller cable lines/landings	• (CLTC) • Smaller telecommunications companies (Kamatchi, for example)
Anticipated cable landing sites	• Telecommunications companies
Telecommunications lines	• National Telecommunications and Information Administration (NTIA) • Federal Communications Commission (FCC) • GTA Teleguam Inc. • NTT Ducomo, Inc. • IT&E
Fuel terminals	• None provided
Fisheries and Marine Data	
Fisheries data	• NOAA NMFS • NCRMP • Fishery independent surveys • Fish aggregating device (FAD) data • NOAA creel surveys • US Navy MIRC • Guam Fishery Independent Surveys from Galvez Banks in 2010, 2012 and 2014 • Vessel monitoring system (VMS) data • NMFS Marine Recreational Information Program (MRIP) • Western Pacific Fisheries Information Network (WPacFIN) • Garmin Sea Mapping • “Active Captain” application
2023-2024 fisheries survey data for Saipan Lagoon	• Nathan Van Ee, Ph.D., CNMI DFW

Table 3. *Continued*

Available Data	Lead(s) to Acquire
Fisheries and Marine Data *(Continued)*	
Fisheries landing data	• NMFS
Bottom fish mapping	Ben Richards, NMFS PIFSC Fisheries Independent Mapping (2024)
Small scale fishing trip data	• None provided
Fishing sites	• "Active Captain" Application
CNMI FAD locations	• CNMI Division of Fish and Wildlife • Guam DOAG DAWR
FAD locations	• Nathan Van Ee, Ph.D., CNMI DFW
Areas regulated by fishery management plans	• Joey Lecky and Becky Walker, NMFS
Offshore and nearshore spawning sites	• Guam DOAG DAWR
Other	
Wastewater and sewage outfalls	• None provided
Mitigation sites	• USACE • NMFS • David Delaney or Sean Hanser, NMFS HCD
Additional radar sources aside from weather radar	• Guam International Airport
Tourism data	• None provided
Cruise ship data	• Port of Guam
Applicable data	• Laurie Raymundo, Peter Houk, and Austin Shelton, UOG

Data gaps for the *Industries* sector:

- Defined transportation lanes
- Important tourism areas
- Small vessel fishing data, including locations, landings, etc.
- Fisheries species critical habitat areas
- Indigenous fishing areas
- North side of Guam recently identified as major fishing ground, however, limited fishing data available for the area

Session 5

OFFSHORE WIND

Frank Pendleton, GIS Specialist with BOEM, showed how data will be compiled for the *Offshore Wind* sector, including data relevant to the siting of offshore wind, distance from shores/ports, and wind speed.

Much of this data development work has yet to be done in Guam. That said, NREL, working in close coordination with BOEM, has put forward a robust methodology in other regions to better understand the LCOE associated with OSW. Efforts in Guam are a work in progress. A 12-month interagency agreement is currently in place between NREL and BOEM to assess wind resource data and conduct spatial and temporal cost analyses of offshore wind development. NREL needs to acquire windspeed data from any sources that may have this information (e.g., where/when does wind occur). Ultimately, data sets produced will show when it is windy at different times of day, and different data sets will be developed for different months. Frank noted that bathymetry and distance from shore are also key factors in determining LCOE. One participant shared that CNMI DFW has a weather station attached to its building. NMFS can reach out to DFW for the full data set. The link for the live data is available here.

Workshop participants did not explore the core data questions during this session given that data sets for this sector are still under development. After the presentation, group discussion pivoted to anticipated OSW work in the coming year with questions or concerns that need further discussions. Topics put forward, followed at times by brief responses from BOEM staff, focused on whether or not modeling can occur in a data poor environment, a desire for examples of the smallest scale OSW in U.S. waters, and the timeline for delineating WEAs in Guam. Some posed questions about whether earlier developed east coast NREL LCOE models have been validated.

KEY TAKEWAYS AND NEXT STEPS

As the workshop came to a close, individual participants shared key takeaways and emerging insights to support marine spatial planning in Guam. Many highlighted the need for better engagement with a broader set of data specialists and other interested parties, particularly at the local level. Other comments and concerns expressed at the conclusion of two days of collaborative data development are below.

- "We're data poor in this area. This is great opportunity to increase the data not just for OSW but for other opportunities as well. If there is a way to expand the data sets this also could help Guam with other planning needs for infrastructure."

- "This workshop is a reminder that it's good to make connections and be in the room with folks. Now agencies can communicate directly with people in Guam about data. It's a really positive thing to have made these connections."

- "It's a glaring concern that Guam just doesn't have a lot of the needed data, and we don't yet have some important players involved, at least not at this workshop. Future efforts should aim to galvanize greater participation from those groups that we identified that need to be part of the work."

- "I appreciate NOAA and BOEM's efforts to advance this work. Getting local organizations and people to attend workshops like this is our responsibility here in Guam. We need a call to action, both with Guam Task Force members and others in the community, to acquire much of the data that we've talked about over two days together."

- "At the local level we need to do targeted follow-ups with specific groups. I can help facilitate those connections. It will be good to have more communication between the people of Guam and those from BOEM and NOAA who do this work. Perhaps future meetings can be held in a virtual format. We might get more participation that way."

- "We did a lot of great work over two days together, yet were clearly missing some key groups."

- "We found it both useful and workable to participate in this workshop in a virtual setting. It was also helpful having the webmapper and data inventory available to us during all these data layer discussions."

Dr. Morris and Jessica Carlton thanked workshop participants for their commitment to this collaborative data development effort, then reviewed the next steps that will guide work in the months ahead:

- Develop and distribute the workshop report (NCCOS website, technical memo)
- Follow up on identified data leads – the NCCOS team will be in touch
- Continue to develop the NCCOS marine spatial planning data inventory/ geodatabase
- Work with territorial and federal governments on planning priorities
- Incorporate identified best-available data into BOEM's OSW planning priorities

Dr. Morris concluded by reminding the group that how the data layers are used to inform marine spatial planning and potential development in the ocean environment is of paramount importance. He again thanked everyone for their commitment to thoughtful and inclusive collaboration as the workshop adjourned.

APPENDIX A: Acronyms and Abbreviations

AFB	Air Force Base
AIS	Automatic Identification System
AOA	Aquaculture Opportunity Area
BECQ	CNMI Bureau of Environmental and Coastal Quality
BOEM	Bureau of Ocean Energy Management
BSEE	Bureau of Safety and Environmental Enforcement
BSP	Guam Bureau of Statistics and Plans
CLTC	CHamoru Land Trust Commission
CNMI	Commonwealth of Northern Mariana Islands
CREST	Coastal Resilience Evaluation and Siting Tool
CSS	Consolidated Safety Services
DCRM	CNMI Division of Coastal Resources Management
DFW	CNMI Department of Fish and Wildlife
DOAG-CRI	Guam Department of Agriculture - Coral Reef Initiative
DOAG-DAWR	Guam Department of Agriculture - Division of Aquatic and Wildlife Resources
DOD	Department of Defense
DPR	Guam Department of Parks and Recreation
EFH	Essential Fish Habitat
EPA	Guam Environmental Protection Agency
ERA	Ecological Reserve Area
FEMA	Federal Emergency Management Agency
FAD	Fish aggregating device
FCC	Federal Communications Commission
Guam Task Force	BOEM Guam Intergovernmental Renewable Energy Task Force
GWA	Guam Waterworks Authority
HAPC	Habitat Areas of Particular Concern
HF	High frequency radar
HPO	Guam Historic Preservation Office
MIRC	U.S. Navy Marianas Island Range Complex
MRIP	NMFS Marine Recreational Information Program
MTBAP	NOAA Marine Turtle Biology and Assessment Program
MTMNM	Marianas Trench Marine National Monument
NAVFAC	Naval Facilities Engineering Systems Command
NCCOS	National Centers for Coastal Ocean Science
NCRMP	National Coral Reef Monitoring Program

NGS	NOAA National Geodetic Survey
NOAA	National Oceanic and Atmospheric Administration
NOAA CoRIS	NOAA Coral Reef Information System
NOAA CUSP	NOAA Continually Updated Shoreline Product
NOAA NCEI	NOAA National Centers for Environmental Information
NOAA NCEP	NOAA National Centers for Environmental Prediction
NOAA NMFS	NOAA National Marine Fisheries Service
NOAA PIRO HCD	NOAA Pacific Islands Regional Office - Habitat Conservation Division
NMFS HCD	NOAA National Marine Fisheries Service, Habitat Conservation Division
NPS	National Park Service
NTIA	National Telecommunications and Information Administration
NWS	National Weather Service
RICHARD	Ranier Integrates Charting, Hydrography, and Reef Demographics
OTEC	Ocean thermal energy conversion
PacIOOS	Pacific Islands Ocean Observing System
PacMAPPS	Pacific Marine Assessment Program for Protected Species
PDC	Pacific Disaster Center
PIBHMC	NOAA Pacific Islands Benthic Habitat Mapping Center
ROMS	Regional Ocean Modeling System
SHPO	State Historic Preservation Office
UNEP	United Nations Environment Programme
UOG	University of Guam
U.S.	United States
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USGS	United States Geological Survey
VMS	Vessel Monitoring System
WEA	BOEM Wind Energy Area
WERI	Water and Environmental Research Institute of the Western Pacific
WPacFIN	Western Pacific Fisheries Information Network
WRF	Weather research and forecasting

APPENDIX B: Workshop Agenda

Day 1
The Guam Museum: Thursday, September 12, 2024

Time (ChST)	Activity
8:30 am – 9:00 am	Registration
9:00 am – 9:30 am	Welcome and Agenda Review
9:30 – 10:30 am	Overview of NOAA's Marine Spatial Planning Process and How It Informs BOEM's Offshore Wind Planning Process
10:30 am – 10:45 am	Break
10:45 am – 12:00 pm	Session 1: Natural and Cultural Resources
12:00 pm – 1:00 pm	Lunch Break
1:00 pm – 2:30 pm	Session 1: Natural and Cultural Resources (continued)
2:30 pm – 2:45 pm	Break
2:45 pm – 4:30 pm	Session 2: Metocean and Other
4:30 pm – 5:00 pm	Wrap Up Day 1 and Preview Day 2

Day 2
The Guam Museum: Friday, September 13, 2024

Time (ChST)	Activity
8:30 am – 9:00 am	Registration
9:00 am – 9:15 am	Recap of Day 1 and Preview Day 2
9:15 – 10:30 am	Session 3: National Security
10:30 am – 10:45 am	Break
10:45 am – 12:00 pm	Session 4: Industries
12:00 pm – 1:00 pm	Lunch Break
1:00 pm – 2:15 pm	Session 5: Offshore Wind
2:15 pm – 2:45 pm	Key Takeaways and Next Steps
2:45 pm – 3:00 pm	Closing Remarks

APPENDIX C: Workshop Participants

In-person Participants

Name	Affiliation
Marie Auyong	NOAA OCM/CSS
Olivia Banez	Guam DOAG - CRI
Jason Biggs, Ph.D.	Guam DOAG DAWR
Doug Boren	BOEM
Jessica Carlton	NOAA NCCOS/CSS
Eliza Carter	NOAA NCCOS/CSS
John Cruz	GPA
Antonio Gumataotao Jr.	GPA
Sarah Hile	NOAA NCCOS/CSS
Lauren Kaiser	PacIOOS
Joey Lecky	NMFS PIRO
Deanna Meier	BOEM
Jen Miller	BOEM
James Morris, Ph.D.	NOAA NCCOS
James Pangelinan	Guam BSP CMP
Frank Pendleton	BOEM
Dave Pereksta	BOEM
Michael Rasser, Ph.D.	BOEM
Rockne Rudolph	BOEM
Laughlin Siceloff	NOAA NCCOS/CSS
Necy Sumait	BOEM
Ed Sweeney	NOAA NCCOS/CSS
Esther Taitague	Guam BSP CMP
Chuck Wheeler	NMFS PIRO
Ashton Williams	Guam DOAG – CRI
Rich Wilson	Seatone Consulting (facilitation support)
Meagan Wylie	Seatone Consulting (facilitation support)

Online Participants (via Zoom virtual platform)

Name	Affiliation
David Delaney	NMFS PIRO
Eric Cruz	NMFS PIFSC
Francisco Villagomez	NMFS PIFSC
Henry Hofschneider	CNMI Special Assistant to the Lieutenant Governor
Malia Chow, Ph.D.	NOAA NMFS PIRO
Michelle Lastimoza	Guam EPA
Mona Khalil, Ph.D.	USGS
Monica Guerrero	Guam BSP
Nathan Owens	DOD
Nathan Van Ee	CNMI DFW
Rebecca Walker	NMFS PIFSC
Sean Hanser	NMFS PIRO
Steve McKagan	NMFS PIFSC
Steve Sample	DOD
Yuming Wen, Ph.D.	WERI

APPENDIX D: Photo Credits

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