Rutgers
THE STATE UNIVERSITY OF NEW JERSEY

Rutgers University
Offshore Wind Energy Symposium

January 12, 2023
8:30am–4:00pm

Rutgers University–New Brunswick
Weeks Hall, Busch Campus

osw.rutgers.edu

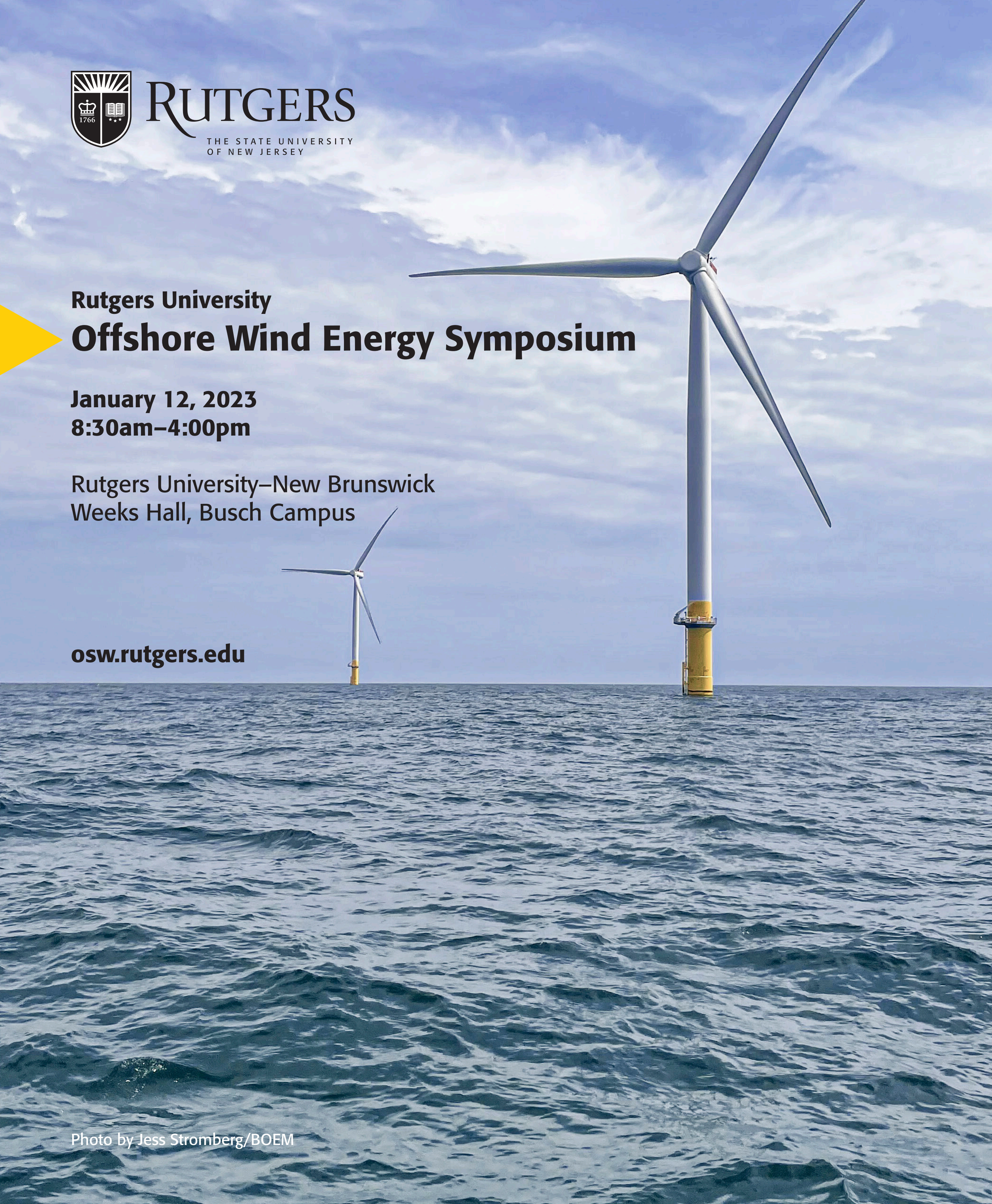

Photo by Jess Stromberg/BOEM

Photo by Stephen Boutwell/BOEM

Thank you to the Rutgers Offshore Wind Collaborative Symposium Organizers.

Onur Bilgen
Peggy Brennan-Tonetta
Laura Flagg
Jeannie Garmon
Josh Kohut
Kevin Lyons
Dave Magnoni
Amy Mandelbaum
Jim Morris
Sean O'Malley
Wade Trappe

Rutgers University
Offshore Wind Energy Symposium

Thursday, January 12, 2023
8:30am–4:00pm
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Busch Campus

Agenda

8:30	**Registration and Breakfast**	1st Floor Lobby
9:00	**Welcome** • Peggy Brennan-Tonetta, Senior Associate Director, NJAES • Michael Zwick, Senior Vice President for Research, Rutgers University • Senator Bob Smith, Chair of the New Jersey Senate Environment and Energy Committee	Room 105
9:30	**Keynote Speaker** Kris Ohleth, Director, Special Initiative on Offshore Wind	Room 105
10:15	**World Café Overview** Wade Trappe, Professor and Associate Dean for Academic Programs, School of Engineering	Room 105
10:20	**Break**	2nd Floor Atrium
10:35	**World Café**	See name badge for assigned room
12:00	**Lunch & Student Posters**	2nd Floor Concepts Lab and Atrium

Free Wi-Fi under "RUWireless" and select "I want Guest Internet Access"

12:45	**Overview of NJEDA Fellowship and University Initiatives Programs** • Introduction – Jen Becker, Managing Director, Wind Institute • Wind Institute Fellowship Program – Chelsie Riche, Assistant Director for Research and Experiential Education, Office of the Executive Vice President for Academic Affairs, Rutgers • Community Events and Shared Learning – Jeannie Garmon, Director of Research Development, Rutgers–Camden; Jim Morris, Associate Vice President of Continuing Studies, Rutgers Division of Continuing Studies; Kevin Lyons, Associate Professor Professional Practice, Rutgers Business School Newark/New Brunswick • Educational Initiatives for a Resilient Offshore Wind Economy in New Jersey – Josh Kohut, Professor, Dept of Marine and Coastal Sciences	Room 105
1:00	**Lightning talks** Josh Kohut, Professor, Department of Marine and Coastal Sciences	Room 105
2:15	**Break**	2nd Floor Atrium
2:30	**Lightning talks** Onur Bilgen, Associate Professor, Department of Mechanical and Aerospace Engineering	Room 105
4:00	**Closing remarks** Peggy Brennan-Tonetta, Senior Associate Director, NJAES	Room 105

Kris Ohleth, Director, Special Initiative on Offshore Wind

Kris Ohleth has worked in the offshore wind sector for nearly 20 years, since the days of the industry's inception in the U.S. Holding senior positions with offshore wind developers, NGOs, and state agencies, she has gained critical insights into the policy and regulations that shape offshore wind activities at the state, regional, and federal levels. Kris has extensive experience working with offshore wind stakeholders and has expert knowledge of such engagements, having worked on offshore wind and ocean policy issues for nearly two decades.

In her current role as the Director of the Special Initiative on Offshore Wind, she leads the organization to develop strategies to support the responsible and sustainable development of the offshore wind industry. Originally from New Jersey, she is a Rutgers University graduate, has a Master's degree from the University of Rhode Island, and currently lives in Morris County, New Jersey with her husband and retired-racing greyhounds.

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Jason Adolf, Professor, Monmouth University Department of Biology
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Integration of Environmental DNA Surveys in Fisheries Monitoring Plans for Offshore Wind

Co-authors: Keith Dunton and Shannon O'Leary

The fish community composition of New Jersey coastal waters and the economic benefits provided by the fisheries they support are the direct result of the current state of the regional continental shelf ecosystem. A concern shared by commercial and recreational fishers, as well as resource managers, is that alterations of the physical habitat of this ecosystem by offshore wind development will change fish community composition, fishing opportunities, and the economy. Well-designed and resilient survey methods built on data collected consistently before, during, and after construction of wind farms are essential to understanding any such impacts of offshore wind development on marine fish community composition. Here, we assess the utility of environmental DNA (eDNA) metabarcoding to collect information on species presence, abundance, and overall biodiversity of fish communities using water samples collected alongside oceanographic conditions before, during, and after construction of a wind farm off southern New Jersey. Environmental DNA sampling is non-extractive, thus minimizing stress to the organisms that are captured, and eliminating sampling related mortality. Further, unlike bottom-tending mobile sampling gear, eDNA sampling can be performed without causing any damage to the benthic habitat, and eDNA does not necessitate the use of fixed vertical lines that can lead to marine mammal entanglements. Finally, eDNA samples can be taken in areas with hard-bottom benthic habitats that cannot be sampled using a trawl or other mobile bottom-tending sampling gear. In conclusion, the continued integration of eDNA alongside ongoing capture surveys will continue to improve efficacy of sampling and processing protocols leading to increasingly reliable results and avenues for including eDNA as a standalone metric in future surveys. We will present initial results and discuss advantages of eDNA monitoring compared to traditional sampling techniques such as trawling while yielding similarly reliable results.

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Impact Assessment of Energy Storage and Offshore Wind Integration within NJ Electrical Grid

In this presentation, we will go over our in-house developed framework that enables impact assessment of energy storage systems (ESS) and offshore winds (OSW) integration within the New Jersey electric grid following the state's ambitious energy targets. The proposed framework aims to quantify the integration impacts of ESSs and OSWs through a set of key performance indicators (KPIs), including economic, environmental, and technical/engineering value factors. The KPIs are designed to aid decision-makers in identifying economically/ environmentally viable and operationally feasible ESS and OSW integration plans considering the New Jersey BPU targets of

2,000 MW of ESSs by 2030 and 3,500 MW and 7,500 MW of OSWs by 2030 and 2035, respectively.

The proposed framework uses publicly available electric grid infrastructure and power generation portfolio data, as well as high-granular electric demand projections estimated/forecasted by leveraging our built-in module that extracts county-level data from the publicly available EDC-level data. The model computes the “best” power generation/storage mix to balance supply and projected demand based on pricing and cost estimations/projections.

Onur Bilgen, Associate Professor, Department of Mechanical and Aerospace Engineering
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Floating Offshore Wind Turbine Mixed-Fidelity Multidisciplinary Control Co-design Optimization Framework

This presentation will introduce a mixed-fidelity multidisciplinary control co-design optimization framework for floating offshore wind turbines. The computational framework, called OpenTurbineCoDe, is designed to integrate, where possible, traditional structural, aerodynamic, aeroelastic models (e.g., OpenFAST) and advanced control algorithms with higher fidelity simulation tools including Reynolds-averaged Navier–Stokes (RANS) solvers, and three-dimensional structural finite element solvers. All the high-fidelity tools used in this research provide numerically exact gradients to facilitate both efficient optimization and local linearization for control implementation. This research is supported by the Department of Energy (DOE) Advanced Research Projects

Photo by Dennis Schroeder, NREL 40469

Agency-Energy (ARPA-E) Aerodynamic Turbines Lighter and Afloat with Nautical Technologies and Integrated Servo-control (ATLANTIS) Program award DE-AR0001186 entitled "Computationally Efficient Control Co-Design Optimization Framework with Mixed-Fidelity Fluid and Structure Analysis."

The goal of the ARPA-E ATLANTIS Program is to develop new technologies for floating offshore wind turbines, or wind farms, using the discipline of control co-design (CCD.) In this context, we developed a computationally efficient optimization framework for design of floating offshore wind turbines. Our specific aim is to utilize high-fidelity structural, aerodynamic, aero-structural tools, and to derive control-oriented reduced- or low-order models directly from the high-fidelity tools. We are utilizing a mixed-fidelity modeling approach which means that we are also using low- and mid-fidelity tools when necessary. This research is conducted by a multidisciplinary team consisting of Rutgers University, University of Michigan, Brigham Young University, and the National Renewable Energy Laboratory (NREL).

Laurent Burlion, Assistant Professor, Department of Mechanical and Aerospace Engineering
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Advanced Control of Floating Offshore Wind Turbines

This presentation will briefly describe the control methods traditionally used to extract wind energy power using a bottom-fixed wind turbine. Next, we will discuss the control challenges posed by offshore wind turbines and our current research efforts. Finally, we will discuss the robust constrained control methods recently implemented in our computational framework, called OpenTurbineCoDe. This research is supported by the Department of Energy (DOE) Advanced Research Projects Agency-Energy (ARPA-E) Aerodynamic Turbines Lighter and Afloat with Nautical Technologies and Integrated Servo-control (ATLANTIS) Program award DE-AR0001186 entitled "Computationally Efficient Control Co-Design Optimization Framework with Mixed-Fidelity Fluid and Structure Analysis."

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Active Aerodynamic Flow Control

Active aerodynamic flow control is a tool that can be used to manipulate a flow on demand, at times even taking advantage of inherent flow instabilities to achieve a favorable result. Being active, flow control can be turned on and off when necessary. Modern unsteady techniques like synthetic jets and dielectric barrier discharge actuators can achieve flow manipulation without the need for compressed airlines and can operate on existing turbine blade shapes. By issuing a jet normal to the surface of blade, improved aerodynamic performance is achievable, which can have direct benefits for wind energy generation.

For this brief overview, I will quickly go over synthetic jets and their applications to bluff body aerodynamics, which was performed specifically with a focus on wind power generation within an urban environment. I will further provide examples of work being currently performed at Rutgers to implement synthetic jet actuators into radio-controlled airplane. Finally, I will close with a brief summary, including work performed by colleagues within our department involving dielectric barrier discharge actuators.

Sean Duffy, Associate Professor, Department of Psychology
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The Psychological Dimensions of Offshore Wind

This presentation will discuss a case study that uses adoption of wind energy to examine psychological dimensions that affect the way people think, act, and behave with respect to climate change and sustainable technology. Drawing upon recent empirical research in the field of environmental psychology, it will focus on specific issues associated with the use of wind energy – including concerns about the aesthetics of windmills on the natural environment, about the perceived effects of offshore wind farms on coastal economies, and controversial claims about the effect of wind turbine infrastructure on avian and marine life. The case study will be to inform students about how human psychology affects how people think about this new technology specifically and more broadly about how psychology can help promote the adoption of sustainable practices that ultimately may play a crucial role in slowing, halting, and reversing the effects of climate change.

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Artificial Intelligence-Powered Rutgers University Weather Research and Forecasting Model

The rising U.S. offshore wind industry, especially off the U.S. North Atlantic coast, holds great promise, both environmentally and economically, as a clean, domestic, and renewable source of energy. Yet, the reliable operation and integration of those, yet-to-be-operational, offshore wind farms will be contingent on accurate, short-term offshore wind forecasts. Relative to their onshore counterparts, those offshore wind developments will be installed at partially unexplored territories, where our meso-scale meteorological models often exhibit notable forecast biases, and our local measurements are fairly sparse. To that end, I will present a spatio-temporal offshore wind forecasting model, called the AI-powered Rutgers University Weather Research & Forecasting (AIRU-WRF) model, which fuses numerical weather predictions (NWPs) from a meso-scale model operated by Rutgers (RU-WRF) with local observations collected by NYSERDA from the NY/NJ Bight, in order to make wind speed forecasts that are short-term (minutes to hours ahead), and of high resolution, both spatially (site-specific) and temporally (minute-level). In contrast to purely data-driven methods, or those that are solely based on physics, we undertake a "physics-guided" data science approach which captures salient physical features of the local wind field without the need to explicitly solve for those physics.

Exhaustive numerical experiments using data from the NY/NJ Bight—where several ongoing offshore wind developments are in close proximity—suggest that the proposed model outperforms prevalent benchmarks in the wind forecasting literature and practice, in terms of both point and probabilistic forecasting evaluations.

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A Decade of Offshore Wind Energy Research supporting the New Jersey Board of Public Utilities

Photo by Dennis Schroeder, NREL 40465

The Rutgers University Center for Ocean Observing Leadership (RUCOOL) recently celebrated 30 years of continuous ocean observing in the Mid Atlantic. Through technology transitions enabling scientific discovery, student education, and service to New Jersey and the nation, RUCOOL has developed and continues to operate a regional-scale ocean observing network that includes: (a) ground stations for satellite data acquisition, (b) a High Frequency (HF) Radar array (>40 stations covering 1000 km of coast) for surface current mapping, and (c) a fleet of autonomous underwater gliders for sustained subsurface physical, biological and chemical observations.

Over the last decade, the New Jersey Board of Public Utilities (NJBPU) has supported RUCOOL research that leverages New Jersey's vast ocean observing capabilities to inform the development and operation of a regional high-resolution atmospheric model. The Rutgers version of the community Weather Research and Forecast (WRF) model more accurately accounts for the local ocean conditions and outperforms standard national products in offshore validation studies. The combined observation and modeling system has been used to study (a) the seasonal climatology and variability of the offshore wind resource, (b) the impact of coastal upwelling on seabreezes in the offshore wind energy development areas, and (c) the co-evolution of the atmosphere and ocean during intense hurricane forcing.

The NJBPU project currently includes three topic areas supporting State offshore wind initiatives: (a) engagement with the offshore wind community to better determine information needs, (b) sustained operation and validation of the RUWRF forecast model to assemble a long-term resource database, and (c) offshore wind energy research topics of interest including the impact of coastal processes on the daily variations in the wind resource, as well as the wake effects of simulated wind farms on the downstream windfields.

Zhiziong Guo, Professor, Department of Mechanical and Aerospace Engineering
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Microcapsulated and Doped Phase-Change Materials for Energy Storage and Related Applications

I will briefly introduce our recent research work on enhancing heat transfer and increasing functions via micro encapsulation and doping of phase-change energy storage materials. Energy storage is an important part of renewable energies. To use energy efficiently is to store and manage it. Energy storage also reduces the discrepancy between energy supply and demand as well as plays a vital role in saving of energy by converting it into other reliable forms. Thermal management is critical in high-power devices. Phase-change material paraffins are commonly considered in thermal energy storage and management systems. Disadvantages such as low thermal conductivity, low thermal stability, and leakage may prevent paraffins in practical applications. Encapsulation and additives could resolve these issues.

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Rutgers WIndIgnite, Offshore Wind Supply Chain Development: Challenges and Opportunities

Co-authors: Lori Dars and Margaret Brennan-Tonetta

Offshore wind development has very strong national, regional and statewide development targets. The US has a goal to deploy 30 gigawatts OSW energy by 2030, which would support 77,000 jobs, 10 millions homes and cut 78 million metric tons in carbon emissions. New Jersey's offshore wind goal has several steps as to achieve 3,500 megawatts by 2030 and 7,500 megawatts by 2035. Additionally, the new EO #307, increases New Jersey's offshore wind goal by nearly 50 percent to 11,000 megawatts (MW) by 2040. These ambitious goals express that we have challenges, but also great opportunities. The OSW goals can successfully be delivered on time only with a strong supply chain infrastructure from design to manufacturing, installation and operation and maintenance of the turbines. The OSW development is strong in Europe and elsewhere, where the supply chain already exists and is well founded. The OSW supply chain is not at the same maturity in the US and quick and efficient transition is needed. Acceleration of the development of local supply chain will require efficient planning, collaboration, cooperation, outreach and education so that the local exiting businesses can translate their existing expertise to new industry and its emerging supply chain ecosystem. The Rutgers Wind-Ignite Program positions itself to serve as an accelerator program to provide support to underrepresented small business and start-ups to achieve this transition. Rutgers WindIgnite will utilize a network of resources to assist new and existing OSW energy supply chain technology companies to successfully maneuver the innovation pathway. This pathway includes discovery, concept assessment, business model assessment, technology verification, scale-up and commercialization to support emerging offshore wind industry in New Jersey and Mid-Atlantic Region. The ultimate goal is to provide a solid network for supply chain industry growth and to maximize the economic development impacts that it can generate.

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Mid-Atlantic Ocean Data Portal

The Mid-Atlantic Regional Council on the Ocean (MARCO) was established in 2009 to enhance the vitality of the region's ocean ecosystem and economy. One of MARCO's first action items was the development of the Mid-Atlantic Ocean Data Portal (ODP) to serve as an on-line platform to engage stakeholders across the region with the objective of improving their understanding of how ocean resources and places are being used, managed, and conserved. A key component is the Marine Planner, an interactive map-based visualization and decision support tool. The MARCO ODP is a publicly accessible resource that consolidates available data and enables agencies, industry, community leaders, and ocean users to visualize and analyze ocean resources and human use information such as fishing grounds, recreational areas, marine wildlife and habitats, shipping lanes, and energy sites, among others. Over the past decade, the MARCO states have applied the ODP as a means to break down silos among decision-makers, to facilitate a step back and to enable a "big picture" of their ocean and the potential implications of coastal decisions and policies. More recently, offshore renewable energy development is one of the key drivers behind concerns over ocean space allocation. The ODP is being used by a diverse array of stakeholders and the public during the permitting and leasing phases of offshore wind energy projects to better understand the implications of this new use of the MidAtlantic Bight.

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NJEDA Offshore Wind Port Purchasing Disparity Study

During the period July 6–September 15, 2020, Dr. Lyons, the Rutgers Business School Public Private Community Partnerships (RBS-PPCP) and faculty and from Supply Chain Management and graduate students (the Rutgers Team) conducted a comprehensive purchasing disparity study for the development and construction of the South Jersey Off-Shore Wind Port Manufacturing Facility. This research project and report are called "disparity studies" because they determine if there is a disparity between the utilization and availability of minority, women, veteran, LGBT-owned firms in the awarding of major construction contracts. Dr. Lyons and his team were contracted by NJEDA to assess potential disparities between the participation and availability of minority, women, veteran, LGBT-owned businesses across the commodity and professional services categories that could be part of the bid, purchasing and contract process for the New Jersey Wind Port Project. Our goal was to provide data analytics and information that NJEDA will use to refine ordinances, regulations, policies and purchasing processes to aggressively cultivate, build the capacity, competitively bid, and award contracts with minority-, women-, veteran- and/or LGBT-owned businesses ("MWVLOBs") (directly and through its contracted representatives – via tier-level contracting). As a result of this research, the contracts awarded to diverse suppliers has surpassed the goals set by NJEDA and has provide significant opportunities for diverse business and workers to be a part of New Jersey's 'green economy!' This session will provide insights into the disparity research study, the current progress on the New Jersey Wind Port Manufacturing Facility and Dr. Lyons' efforts to develop the most comprehensive supply chain system and robust diverse and inclusive economy for offshore wind for New Jersey.

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Offshore Wind and the Mid-Atlantic Cold Pool

The Mid-Atlantic Cold Pool is a seasonal mass of cold bottom water that extends throughout the Mid-Atlantic Bight (MAB). The Cold Pool forms from rapid surface warming in the spring and dissipates in the fall due to mixing events such as storms. The Cold Pool supports coastal ecosystems and economically valuable commercial and recreational fisheries along the MAB. Offshore wind energy has been rapidly developing within the MAB in recent years. Studies in Europe demonstrate that existing wind lease areas can impact seasonal stratification; however, there is limited information on how MAB wind development will affect the Cold Pool. Seasonal overlap between the Cold Pool and wind lease areas in the Southern New York Bight along coastal New Jersey was evaluated using a data assimilative ocean model. Results highlight overlap periods as well as a thermal gradient that persists after bottom temperatures warm above the threshold typically used to identify the Cold Pool. These results also support cross-shelf variability in Cold Pool evolution. This work highlights the need for more focused ocean modeling studies and observations of the Cold Pool and MAB wind lease area overlap.

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Fisheries Monitoring of an Offshore Windfarm: Bottom Trawl Survey

Co-author: Douglas Zemeckis

It is critical that fishery monitoring plans (FMPs) are established to evaluate the impacts of offshore wind development on natural resources. In 2024, construction is scheduled to begin for an 1,100 MW windfarm located approximately 24 km east of Atlantic City, New Jersey. Our team is implementing a comprehensive FMP at this wind farm using several different extractive and non-extractive fisheries surveying methods. This talk will focus on one of the extractive methods, a bottom trawl survey, that will be used primarily to evaluate the impact of wind farm construction and operation on fish assemblage and abundance. Our team will conduct a before-after-control-impact experiment by trawling seasonally for six years within the wind farm and at a nearby control location of similar size and habitat characteristics. Pre-construction trawling will occur for up to two years and will provide comprehensive baseline data on fish assemblage and abundance. Trawling will then continue for two additional years while the wind farm is being constructed and for two years after construction of the wind farm is complete. A pilot bottom trawl study conducted at a similar lease site suggested a sample intensity of 1 tow/15 km^2 would provide the statistical power adequate to detect moderate to large effect size for several economically important species in the region. Therefore, we plan to conduct twenty tows within the wind lease area and twenty tows at the control site during each sampling season. In this presentation we discuss the design of this survey and some potential paths for integrating wind farm fisheries monitoring data like this with longer-term, regional-scale fishery dependent survey data.

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Surveys and Experiments for Monitoring Surfclams at Offshore Wind Projects

Photo by Dennis Schroeder, NREL 40475