

Activity Area Overview Presentation: Offshore Wind Demonstrations

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Activity Team



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Context: U.S. - Specific Offshore Challenges

Steep learning curve required –
European solutions may not be optimal or appropriate to:

- Challenging physical conditions – e.g. hurricanes, ice, geophysical characteristics
- Available vessels and Jones Act restrictions
- Supply chain, port infrastructure and workforce training needs
- Permitting processes and state or federal regulations
- Wildlife considerations, visual impacts and potential marine use conflicts
- Deep water – nearly 60% of the offshore wind resource in the U.S. is in deep water, nearly 100% on Pacific Coast



FY21 Peer Review – Activity Overview

Activity Summary:

- Reducing offshore wind energy costs
- Reducing financing & permitting risks
- Accelerating the rate of offshore wind deployment
- Decreasing environmental barriers to deployment or operation
- Validating innovative solutions beneficial to multiple commercial applications
- Since FY19, annual Congressional direction (\$10M)
 - Varying language – FY19/FY20 directed to be competitive, FY21 directed to “demonstration programs”

Partners:

- University of Maine, RWE, Diamond Offshore Wind
- Lake Erie Energy Develop Co (LEEDCO)
- Atkins (FY20 award in negotiation)

Activity Objective(s) 2019-2020:

- Secure Power Purchase Agreements and industrial partners
- Resolve legal and permitting challenges
- Continue Front-End Engineering Design of both designs
- UMaine – Switch from 2 x 6MW to 1 x 10MW

Overall Activity Objectives (life of Activity):

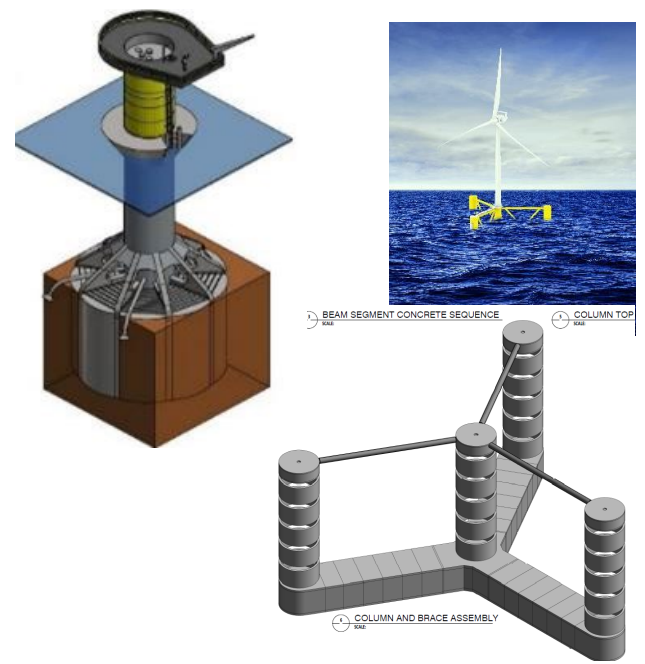
- Reduce the cost of energy and address regional challenges and opportunities
- Reduce perceived industry risks
- Expedite development of the US offshore wind industry

FY19 - FY20 Budget Under Review (Labs): \$0
FOA Project Budget*: \$422M
- Total DOE: \$126M
- Total Cost Share: \$296M

* Includes Atkins FY20 Award

Current budget (FY21): \$10M^
^ FY21 awards in negotiation

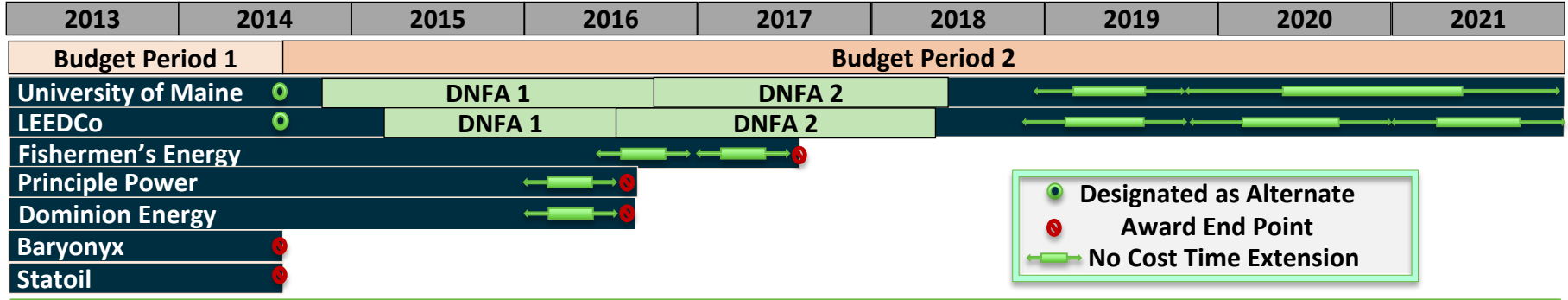
Number of projects under peer review: 2



Projects Under Review

Project Title	Performer
T01 – University of Maine Offshore Wind Demonstration	University of Maine Dr. Habib Dagher
T02 – LEEDCo Offshore Wind Demonstration	Lake Erie Energy Development Corporation (LEEDCo) David Karpinski

OSW Demonstration Projects – Brief History



2013 - Seven Projects awarded for Budget Period 1

- Regionally and technologically diverse
- Goal: 50% Front End Engineering Design (FEED) including vendor quotes
- Down-Select based on progress and technical viability

2014 – Five Projects move to Budget Period 2 (three prime, two alternates)

- Goal: 100% FEED, vendor quotes, installation and O&M, completion of National Environmental Protection Act (NEPA), regulatory and interconnection requirements
- Go/No-Go based on progress to accomplishing goals, including power purchase agreement

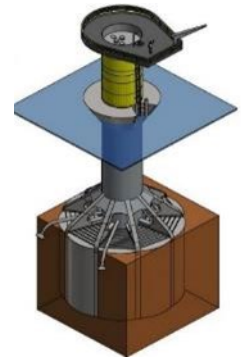
2017 – Two Projects continue in Budget Period 2 (alternates moved to prime)

- Goal: Fabrication, installation and commissioning of the project by 2020; data collection 5-years beyond project completion
- Regular Go/No-Go decision points

Current Portfolio

LEEDCo - Icebreaker Wind

- Cleveland, OH
- 20.7 MW project, 6 turbines
- Mono Bucket (monopile large suction pile) to resist weak soils surface ice conditions of the Great Lakes
- Budget Period 2 of 5



University of Maine – Aqua Ventus 1

- Monhegan Island, ME
- Up to a 12 MW project, 1 turbine
- Floating concrete semi-submersible to handle deep-water offshore wind
- Budget Period 2 of 5



OSW Demonstration Projects

- University of Maine NE Aqua Ventus I: Project Overview

Project Overview

- A single 10+ MW floating offshore wind turbine utilizing concrete semi-submersible foundation
- Turbine Type: One 10 MW class offshore wind turbine
- Distance from Shore: 3 Miles south of Monhegan Island, Maine [State Waters]
- Water Depth: approximately 90-120 meters
- Project Cost: \$150m-\$200 million

Project Technology Highlights

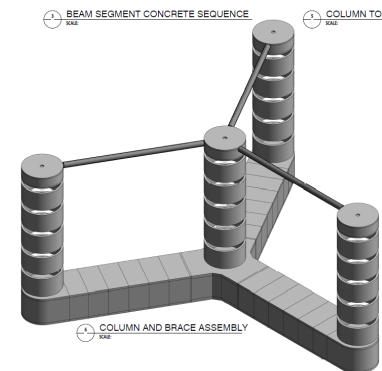
- Unique floating concrete foundation design
- Technology can be installed with minimal noise and seabed disturbance
- Turbine can be installed and commissioned in port and towed to the project site

Power Purchase Agreement (PPA)

- UMaine has a fully executed 20-year Power Purchase Agreement with Maine Central Power

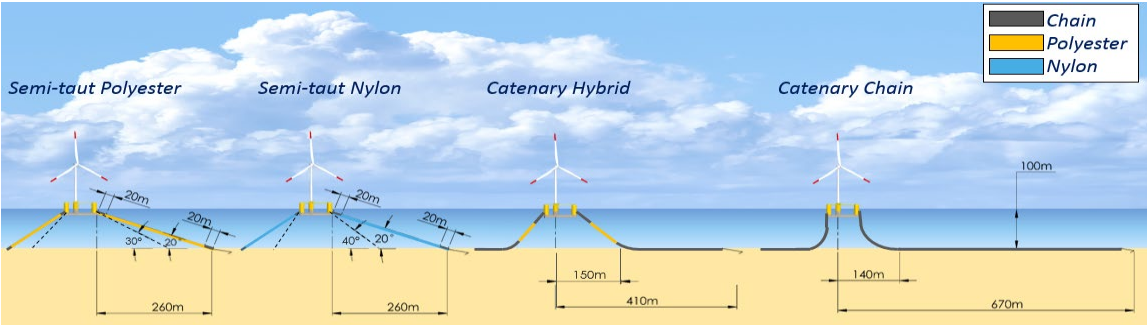
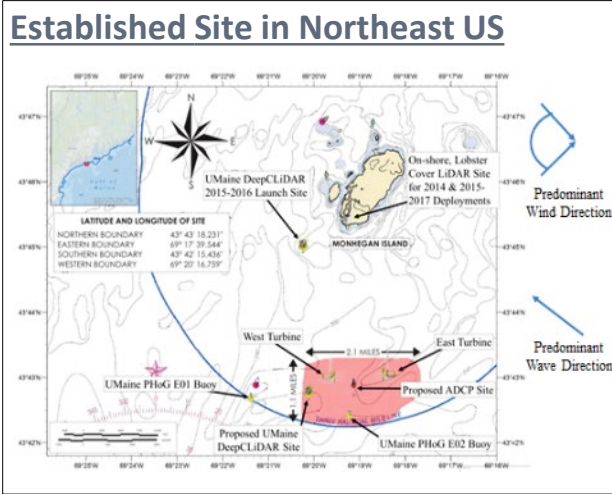
\$100M Project Investment by New England Aqua Ventus (NEAV)

- UMaine team has partnered with NEAV, joint venture between Diamond Offshore Wind and RWE (second largest OSW developer in the world)
- NEAV will perform project development, procurement, construction, and installation
- NEAV will provide both technical insight, capital, and risk reduction capabilities



UMaine: New and Changed Scope since FY19

- **Update Project Design from Two 6MW Turbines to a Single 10+ MW Turbine (FY19 \$5M)**
 - Perform a hull redesign to incorporate a larger, wind turbine to optimize performance and ensure the project provides the most impactful data to the industry
- **Semi-Taut Mooring System Analysis (FY20 \$5M)**
 - 3-line synthetic rope mooring system with small lengths of chain at the hull and anchor point connections.
 - Smaller seabed footprint compared to steel chain catenary systems minimizes impact on fishing.
 - Reduces deployment vessel logistics: easier, less costly to install @ 1/20th the weight of chain.
 - Synthetic ropes are less expensive than chain and less sensitive to fatigue, over 20 years oil and gas experience.



LEEDCo's Icebreaker Wind: *Project Overview*

Icebreaker Wind Project Overview

- 20.7 MW Offshore Wind Project in Lake Erie
- Mono bucket foundation with an ice cone
- Turbine Type: Six 3.45MW MHI-Vestas Turbines
- Distance from Shore: 8 miles north of Cleveland (State Waters)
- Water depth: approximately 20 meters
- Projected Project Cost: ~\$200 million



Project Technology Highlight: Mono Bucket Technology

- Innovative design uses technology utilized in the oil and gas industry
- Technology can be installed without significant noise or seabed disturbance
- The Mono Bucket is geometrically simple, potentially allowing for the utilization of local fabricators

Utilization of Local Supply Chain and Manufacturing

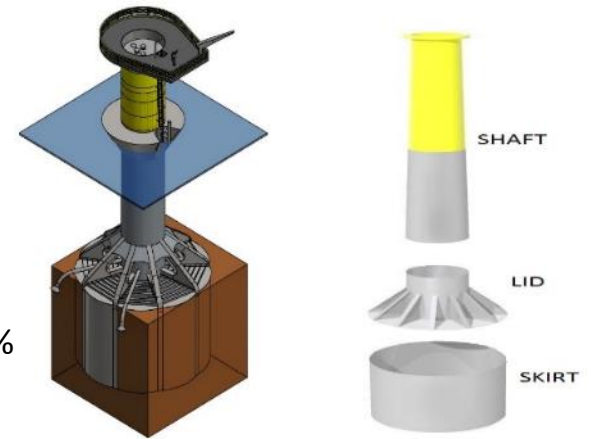
- LEEDCo is committed to utilizing local/regional suppliers in various sectors

Power Purchase Agreement (PPA)

- LEEDCo PPA commitments: Cleveland Public Power- 25%, Cuyahoga County- 8.6%
- LEEDCo continues to pursue full subscription of the rest of the project's capacity

Permitting Activities

- DOE NEPA Review Complete- Finding of No Significant Impact Issued in 2018- ***Currently under litigation***
- Ohio State Permitting- Ohio Power Siting Board Issued Certificate of Environmental Compatibility and Public Need in 2020- ***Opponents filed appeal of Certificate to Ohio Supreme Court***



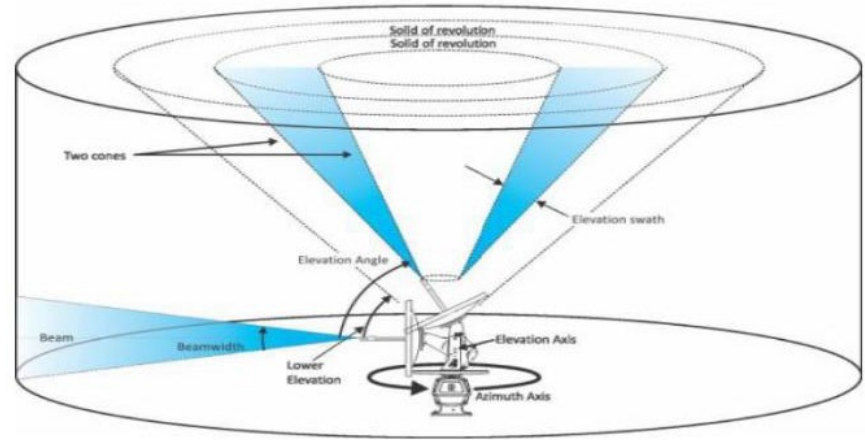
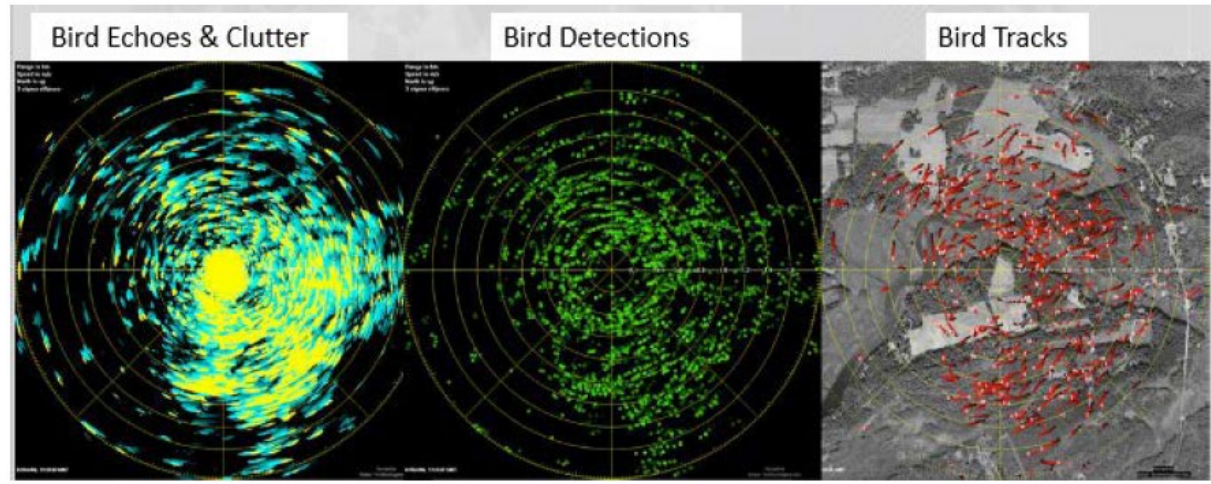
FY2019 OSW DEMO FOA

Establishing an Avian Impact Assessment Protocol for OSW in the Great Lakes

PARTICIPANTS



The UNIVERSITY of OKLAHOMA.
Office of Research Services



Employ avian radar, NEXRAD, mobile Doppler, thermal imaging cameras, and ceilometers, side-by-side, to research correlations and determine the most effective means to assess risk to birds.

Atkins-HOE: Project Overview

Program Description

- Project development to design a full-scale 10+MW floating offshore wind turbine platform (FOWT) to be constructed and installed in the Mayflower Wind lease area
- Develops Ocergy’s steel semi-submersible platform with a compressed air trim system
- Platform is promising for industrialization at US facilities
- Integrates with Mayflower Wind Project – major risk reduction
- Excellent team with extensive floating design, permitting, and construction experience



Project Status

Award currently in negotiation

Program Summary

Phase	Key Milestones & Deliverables
Pre-FEED	<ul style="list-style-type: none"> • Project Design Basis incorporating key lessons learned, risks and opportunities
FEED	<ul style="list-style-type: none"> • Complete model test and numerical validation • Final configuration of FOWT
Detail design	<ul style="list-style-type: none"> • Obtain permit and Class approvals • Successful FID from project stakeholders

Technology Impact

- Demonstrate a cost-effective methodology for designing FOWTs for U.S. waters.
- Stimulate competition by introducing an alternate substructure for developing U.S. offshore wind farms.
- Inform U.S. supply chain of the requirements for the manufacture and serial fabrication of FOWTs.
- Instigate U.S. leadership in floating wind technology using U.S. offshore engineering expertise.