

## **Great Lakes Wind Energy Center Final Feasibility Study – Fact Sheet Technical, Environmental and Economic Key Findings**

### **Background**

- Cuyahoga County is striving to build the world’s first offshore wind turbine in fresh water and become a center for wind innovation, which can potentially create thousands of manufacturing jobs and attract new businesses to our area.
- It is the Task Force’s vision to establish Cuyahoga County as a primary hub for wind energy in North America, and a key hub for the offshore wind energy industry in the Great Lakes.
- Wind is an everlasting source of clean energy, making it an attractive alternative as energy prices and concerns about global climate change increase.
- Cuyahoga County has completed a Feasibility Study to determine whether to move forward in building a potential offshore wind energy Pilot Project on Lake Erie.
- Project partners will continue to work closely with regulators and advocacy groups to ensure a potential Pilot Project is properly sited and not harmful to wildlife or the environment.
- Funders for the Feasibility Study include Cuyahoga County, the Cleveland Foundation, Case Western Reserve University, City of Cleveland, the Fund for Our Economic Future via NorTech, Cleveland-Cuyahoga Port Authority, and the Generation Foundation.
- Project team members for the Feasibility Study include juwi and its subsidiary JW Great Lakes Wind, Germanischer Lloyd, DLZ Ohio, Inc., BrownFlynn, Black & Veatch, Curry and Kerlinger, and Econnect.

### **Executive Summary**

- The Feasibility Study investigated the technical, environmental and economic impacts of a potential Pilot Project, 5-20 MW on Lake Erie near downtown Cleveland.
- The potential Pilot Project area is generally three to five miles offshore, and within that area juwi identified nine potential turbine configurations based on a variety of siting criteria.
- Final turbine locations will depend on regulatory consultation and approval, as well as input from key stakeholders.
- The Pilot Project is expected to have minimal environmental impact, primarily due to its small scale.
- Offshore wind energy development is more capital intensive than comparable projects onshore.
- Lake Erie possesses the best wind resource in Ohio.
- The Feasibility Study evaluated eight potential Pilot Project economic scenarios. The capital investment cost estimates range from \$77.2 - \$92.7 million for a 15 to 20 MW project, respectively.
- Results of the report indicate that construction of the Great Lakes Wind Energy Center Pilot Project is feasible, pending approval by regulatory agencies, engagement from community stakeholders, and solutions to make the project more economically viable.

### **Preliminary Site Selection**

- The Feasibility Study reviewed various siting criteria for determining a potential Project area; based on the available information, juwi recommends an area east of the Cleveland water intake Crib.
- The possible Pilot Project turbine locations presented in the Feasibility Study are based on key factors including wind resource, distance to interconnection locations, air navigation and radar, water depth, shipping channels, Cargill Salt Mine, visibility, and the location of underwater features.
- Final turbine locations will require consultation and approval from the Federal Aviation Administration, Ohio Department of Natural Resources, US Army Corps of Engineers, U.S. Fish and Wildlife Service, Ohio Environmental Protection Agency, and other agencies.

### **Wind Resource for the Pilot Project**

- Crib data were provided to juwi by Cuyahoga County for analysis of wind shear and wind speeds at heights above Lake Erie.
- Plans exist to collect further data in the coming months using a robust LiDAR data set to confirm shear and other estimates based on Crib anemometer measurements.
- Compared to onshore sites in Ohio, the measured wind speed at 50 m height from the Crib indicates an excellent resource.

### **Availability Assessment and Energy Production**

- In general the ice coverage on Lake Erie has a significant influence on the ability to perform major corrective maintenance.
- Limited accessibility by service vessels during the ice season reduces turbine availability to produce electricity.
- Energy production estimates from potential Pilot Project configurations range between approximately 37,500 MWh to 55,000 MWh per year.

### **Avian Risk Assessment**

- For offshore wind farms, habitat loss would result from birds avoiding, or not foraging at the turbine locations.
- It is unlikely that the Project site will pose a significant barrier to bird migration or local flight paths on Lake Erie.
- Wind turbines essentially lack the major risk factors implicated in large-scale mortality events involving nocturnal migrants at communication towers.
- Given the Project site being offshore and the infrequent migration of raptors, raptor fatalities are unlikely.
- No fatalities of federally listed endangered or threatened species have been recorded in any of the studies undertaken at onshore projects in the US.
- Collision risk to waterbirds is judged to be low and unlikely to rise to the level of biological significance.

### **Initial Marine Ecological Assessment**

- At this time, there are no ecological concerns that would limit construction and operation of the Pilot Project.
- Construction will cause short-term impacts to the biota relating to temporary habitat loss when the lakebed is disturbed during construction of wind turbine foundations. However in the long term, research indicates such structures provide artificial reef that may enhance the biota.
- Onshore habitat concerns would be concentrated at the point where the cable connecting the wind farm would connect to the existing grid system or new facilities housing electrical-conducting equipment such as transformers. Since the interconnection sites will likely be in already disturbed/developed areas, it is highly unlikely that onshore habitats would be disrupted, or that sensitive (threatened/endangered species would be impacted). The County also is working with the Ohio Department of Natural Resources to choose offshore areas that provide the least amount of impact.
- Potential additional studies/surveys may include: fish distributions around turbines, effects of turbine placement on coastal currents, and effects of electromagnetic fields on fish behavior.

### **Geology**

- The information from generalized geologic references together with the available site-specific data indicates that a wide range of lakebed conditions can be anticipated off the Cuyahoga County shore.
- Due to preliminary soil information from previous studies but subject to final site specific investigations, monopiles currently appear to be the preferred foundation alternative for the Pilot Project.
- Monopiles have been used in similar water depths at European offshore wind projects and if driven will likely be the most economical option.

### **Effects of Icing, Wind and Waves**

- Regarding ice conditions, the proposed locations for the Pilot Project can be considered as one of the more moderate areas of the Great Lakes, with respect to expected ice thickness.
- Ice is expected to be the principal design driver for potential Pilot Project turbines.
- Because of the ice conditions on Lake Erie, an ice cone should be considered on the pile in the waterline to break up ice, reduce loading on the structure and avoid or minimize ice induced vibrations.
- The wind conditions have been investigated and evaluated; the annual average wind speed (at 70 m height, 10-min mean) can be stated to be up to 8.2 m/s, the 50-year extreme wind speed (at 70 m height, 10-min mean) is ~ 38 m/s.
- The overall impression of the Lake Erie Project site is that the wind conditions tend to be gentle with respect to the structural integrity of the turbines.
- Compared to offshore conditions in the German North Sea and the Baltic Sea, extreme wave conditions on Lake Erie are moderate. Maximum wave heights (50 years) on Lake Erie reach 7.8 m, which is less than half as high as extreme waves e.g. in the German North Sea.
- The existing environmental conditions at the potential Lake Erie Project site have considerable influence on the turbine substructure design. The soil conditions and water depth will influence the design selection.

### **Conceptual Design**

- On the basis of a comparison of actual wind data requirement it was concluded that for a future Pilot Project, wind turbines of GL wind class II will be suitable. As Lake Erie has freshwater conditions, offshore wind turbines with high wind class and special air routing systems will not necessarily be required.
- A monopile structure seems to be the most suitable foundation concept for the Pilot Project.
- Because of ice conditions, an ice cone should be mounted to the vertical structure in order to reduce ice loads and minimize the risk of ice induced vibrations.

### **Interconnection and Offshore Cabling**

- Three potential interconnection locations were chosen based on their proximity to the potential Project site, voltage levels and preliminary information and suggestions provided by Cleveland Public Power (CPP) and Cleveland Electric Illuminating Company (CEI).
- Additional interconnection studies are required prior to any new power generation facility. CPP and CEI have both indicated they will conduct the studies internally.

### **Test, Certification, and Advanced Research Centers**

- The Feasibility Study investigated the market potential and demand for creating a Great Lakes Wind Energy Center (GLWEC) to possibly include a Pilot Project (5-20 MW, 2-8 wind turbines on Lake Erie), a Test Center (defined as a facility that allows manufacturers to test new product designs), a Certification Center (defined as a facility to certify the technical acceptability of new wind-related equipment), and an Advanced Research Center (defined as a facility for innovative wind energy research and technology development by public, private and/or academic institutions).
- Regarding a Test Center, viability will be completely dependent on which area testing will be undertaken. Smaller turbine manufacturers without established testing facilities would be more likely to utilize the Center.
- Turbine manufacturers would be interested in utilizing a Certification Center located within the United States. Currently, it is not mandatory to certify turbines or projects within the U.S., however, as the industry grows, investors and developers will push to standardize the quality of the components. It is recommended that Cuyahoga County partner with an established certification body to provide an established reputation, resulting in a faster potential growth rate for this new area of business.
- The market for a Research Center does exist, and would be best served by working closely with an established body (i.e. National Renewable Energy Laboratory), using their reputation to market the Center's capabilities.
- Combining the Pilot Project with the Research Center to train personnel and develop new techniques for accessing turbines is seen as a potential market.
- With respect to each Center, it is recommended that Cuyahoga County partner with established research organizations, certification bodies, and/or academic institutions.

### **Permitting and Regulatory Considerations**

- Agencies required in the regulatory process of siting and permitting a potential Pilot Project include Ohio Department of Natural Resources, Ohio EPA, the United States Army Corps of Engineers, the United States Fish and Wildlife Service, the Ohio Power Siting Board, the Federal Aviation Administration, the United States Coast Guard, and the Ohio Historic Preservation Office.
- Continued consultation with ODNR, other agencies, and various stakeholders will be required to jointly determine a process for responsibly siting wind energy facilities on Lake Erie.

### **Economic Assessment**

- A total of eight different Pilot Project scenarios were evaluated, combining sub-components including wind farm size and turbine type (3-8 turbines, 2.5-5MW turbines), interconnection and onshore facility location.
- Capital investment ranges from \$77.2 - \$92.7 million, and average annual operations and maintenance estimates range from \$2.7 - \$4.6 million.
- Capital and operating costs are much higher than comparable wind projects onshore, primarily due to higher costs associated with offshore installation and maintenance, and small scale.
- The study also assessed the cost of three centers: a test center, a research center and a certification center.

### **Funding and Financing Options**

- Investments associated with a Pilot Project will benefit the offshore wind industry, especially in the Great Lakes, as supporting infrastructure, methods, and equipment are developed, refined and leveraged.
- Capital costs may be reduced by building fewer turbines or a smaller Project.
- Grant or other direct Stimulus dollar funding will improve Project economics.
- The Feasibility Study recommends looking into additional possible sources of funding including grants from the Department of Energy, National Renewable Energy Laboratory, philanthropic organizations, sponsorships or other participation by local/regional organizations or electricity customers.
- Partnering with a turbine manufacturer could be a significant advantage for the Project moving forward, especially if turbines are available at little or no cost.