Executive Summary

This report consists of the compilation and preliminary analysis of relevant data on the Gulf of Maine, to provide important information for parties seeking to respond to the RFP titled: ***Request for Proposals for Long-Term Contracts for Deep-Water Offshore Wind Energy Pilot Projects and Tidal Energy Demonstration Projects***, released September 1, 2010 by the Maine Public Utilities Commission (PUC). As directed by the Maine Legislature under ***An Act To Implement the Recommendations of the Governor's Ocean Energy Task Force***[1], the RFP calls for bidders to propose the sale of renewable energy produced by a deep-water offshore wind energy pilot project that employs one or more floating turbines in the Gulf of Maine (GoM) at a location 300 feet (91 m) or greater in depth no less than ten (10) nautical miles (nmi) from any land area; or a tidal energy demonstration project that uses tidal action as a source of electrical power and that: (1) has a total installed generating capacity of 5 megawatts or less; and (2) is proposed for the primary purpose of testing tidal energy generation technology. As specified in the Act, the PUC may authorize one or more long-term contracts for an aggregate total of no more than 30 megawatts of installed capacity and associated renewable energy and renewable energy credits (RECs) from deep-water offshore wind energy pilot projects or tidal energy demonstration projects, as long as no more than 5 megawatts of the total is supplied by tidal energy demonstration projects. With initial responses due May 1, 2011, the PUC is calling for respondents who have "…experience relevant to tidal power or the offshore wind energy industry, as applicable, including, in the case of a deep-water offshore wind energy pilot project proposal, experience relevant to the construction and operation of floating wind turbines, and have the potential to construct a deep-water offshore wind energy project 100 megawatts or greater in capacity in the future to provide electric consumers in Maine with project-generated power at reduced rates."[2]

In evaluating the potential for the initial development of an up to 30 Megawatt (MW) floating offshore wind project and larger commercial-scale (100 MW and larger) project in federal waters off the coast of Maine, the following criteria are considered:

[1] Public Law, Chapter 615, LD 1810, 124th Maine State Legislature

[2] RFP, Section 2.1 D.

- Met-ocean conditions/Wind Resource –Mean annual wind speeds of at least eight meters per second (8 m/s) or Class 6 winds or better at 50 meters (m) elevation based on wind resource estimates from the United States Department of Energy (DOE) National Renewable Energy Laboratory (NREL)
- Bathymetry – As stated in the RFP, the minimum depth requirement is 300 ft (91 m). There is no maximum depth requirement set forth in the RFP.
- Distance to coastline – As stated in the RFP, the minimum distance to coastline is no less than ten (10) nmi from any land area.
- Environmental resource impacts – The primary environmental resources of concern for offshore wind projects include migratory birds, bats, and threatened and endangered marine species (e.g., North Atlantic right whales). For subsea cable route and nearshore construction, assembly and wet storage areas, impacts to coastal wildlife (including coastal seabird nesting areas), essential fish habitat areas, and coastal threatened and endangered species (e.g., Atlantic salmon and Atlantic sturgeon [proposed-not listed yet]) are also important considerations. Care should be taken to select areas that avoid marine sanctuaries and minimize potential impacts to critical habitat areas.
- Distance to grid interconnection – Minimizing the distance to grid interconnection is particularly important to managing the overall development and construction costs of an offshore wind project. The key findings of an interconnection study regarding distance to grid interconnection points and related subsea cable route include:
    - Fifteen existing substations have been located along the southern coast and mid-coast areas with the capacity to support an offshore wind farm of up to 30 MW. Based on data currently available, it appears the best and most flexible interconnection points are located within the Bath, Wiscasset, Boothbay and Rockland areas
    - Potential subsea cable routes have been identified that will limit the cable length to less than 45 kilometers (km). Dominant conditions on Maine's Inner Continental Shelf (ICS), namely bedrock and mud, do not appear to support easy or cost-effective trenching. It may be possible to plan a cable route in trenchable materials using information currently available; however, additional studies are needed on the muddy areas of the ICS to see if indeed those areas could support the trenching of cables.
- Constructability and supply chain availability – Mid-coast Maine and the Penobscot Bay area have adequate facilities and capabilities to support early stage development of a floating offshore wind farm, including (1) suitable assembly and wet storage areas, with existing port infrastructure and potential industrial waterfront availability; (2) large, medium and small crane, barge and support vessels; (3) local resources for equipment and supplies; (4) local contractors and construction firms experienced with offshore construction and onshore wind power projects; (5) maritime skills and shipbuilding heritage including experience building complex naval vessels and repairing steel ferries and barges; (6) support industries, such as marine steel fabrication and composite

materials manufacturing; and (7) ready access to railways, road and interstate systems, and airports for supply chain accessibility and transportation.

Evaluation and Development of Floating Platform Designs by the University of Maine

Under funding from DOE, the University of Maine (UMaine) has undertaken a multi-year program focused on the development and testing of floating offshore wind energy platforms. As part of this program, UMaine has led a thorough evaluation of more than fourteen different platform technologies submitted by designers from around the world. Starting in 2011, the first of these platform concepts will be designed at an intermediate (approximately 1/3) scale to carry a 100 kW turbine. This first intermediate-scale platform will be fabricated and deployed into UMaine's Deepwater Wind Test Site off Monhegan Island in July 2012, for a period of approximately three to four months. Performance data will be gathered during this deployment, and will be used to refine the design for potential full-scale development. UMaine is currently developing plans to build and deploy additional intermediate-scale platforms in 2013 and 2014, to evaluate multiple platform technologies, validate numerical models, and study the interaction of the platforms with the environment.

Critical Issues

The listed threatened and endangered marine species in the GoM include Atlantic salmon and the North Atlantic right whale. The Atlantic sturgeon has been proposed to be listed as a threatened species. The critical habitat for Atlantic salmon is designated to include all perennial rivers, streams, and estuaries connected to the marine environment. On September 16, 2009, a petition was filed with National Marine Fisheries Service (NMFS) requesting that the critical feeding and calving habitat area for the North Atlantic right whale be expanded to include state and federal waters off the coast of every state along the eastern seaboard from Maine to Florida. The petition focused on the New England coast in particular, requesting that all waters north of Cape Cod out to 200 nmi be designated as critical habitat. The critical habitat for Atlantic sturgeon include watersheds ranging from the Maine/Canada border and extending southward to include all associated watersheds draining into the GoM and wherever these fish occur in coastal bays, estuaries and the marine environment. Atlantic sturgeon has been documented in the Penobscot, Kennebec, Androscoggin, Sheepscot, Saco, Piscataqua, and Merrimack Rivers.

In order to proceed with the permitting process, it is recommended to prepare an extended biological assessment and habitat conservation plan for the proposed project area to (1) evaluate the effects of the project on the co-located species and (2) identify reasonable and prudent alternatives regarding impacts on wildlife and habitats such that the project can proceed. Likewise, it is recommended to provide an Incidental Take Statement consistent with Endangered Species Act provisions or to apply for an "Incidental Take Permit" through United States Fish & Wildlife Service (USFWS) or NMFS depending on the species of concern.

Permitting Considerations

The key permitting regulations for offshore wind project development in the GoM are summarized in Table 8-2 in Section 8.0 of this report. The critical path for state and federal permitting of a <30 MW floating offshore wind project in federal waters is anticipated to be the Outer Continental Shelf (OCS) leasing and permitting process through the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), formerly the Minerals Management Service (MMS). The State of Maine is in consultation with BOEMRE to develop the Maine Deepwater Wind Energy Pilot Project, which would implement a streamlined, three-year process for environmental review of an advanced, deepwater wind energy pilot project, including lease issuance and approval of project-specific assessment plans. The other major state (e.g., Site Law) and federal (e.g., United States Army Corps of Engineers (USACE) Section 404/Section 10) permits are anticipated to require six (6) to 18 months for permit review and approval. As part of the development of the required permit applications, a minimum of two seasons (spring and fall), and likely four seasons, of bird and bat monitoring will be required. Conservatively, the time required to perform these studies, additional required surveys, and prepare the necessary permit applications is estimated to be at least two years. Therefore, prospective developers should expect an approximately five-year permitting process from the start of necessary environmental studies and surveys (two (2) years) to permit issuance (an additional three (3) years beyond studies and surveys under streamlined permitting).

The other major component of an offshore wind project, the subsea cable route to shore and the land-based transmission line to the electric grid interconnection point, will require state (e.g., Site Law) and federal permitting (e.g., USACE Section 404/Section 10). This permit will be particularly focused on impacts to coastal marshland, mudflats, and coastal and freshwater wetlands. As offshore wind energy is regarded as "new" technology in the United States, the USACE permits will be treated and reviewed as a joint application for an Individual Permit. These permits typically require six (6) to 12 months for review; however, the permit application review process may take as long as 18 months depending on the number of comments and additional monitoring or investigation requests from the resource agencies.

The primary environmental stakeholders for offshore wind projects in the GoM include commercial fishermen (mobile-gear and fixed-gear), environmental non-governmental organizations, and coastal residents. In addition, tourism operators, coastal land trusts, and island electric cooperative representatives can also play important roles in supporting or opposing a proposed project.
Early communication and outreach to these stakeholders will be an important component of the permitting process.

Additional Surveys

The following additional surveys will likely be necessary to support design and permitting of a < 30 Megawatt (MW) floating offshore wind project:

Physical and geophysical investigations

- **Desktop studies** - synthesis of known anthropogenic and natural features of relevant importance, including (but not limited to) shipwrecks, fault lines, anticipated sediment types, historical feature migration, historical bathymetry, and the geological history of the area;
- **Topographic and boundary surveys** of the subsea cable connection to shore and along the transmission line route to the interconnection substation;
- **Multi-beam hydrographic survey** of the project area and subsea cable route for the detection of items on the seafloor and an accurate depiction of bathymetric changes;
- **Sidescan sonar** to detect objects on the seafloor that may impact anchor locations or subsea cable routes;
- **Sub-surface profiling** for detecting layers of different materials within the seabed, as well as the possibility of detecting erratics or other features that may make cable trenching difficult;
- **Sediment quality** testing at proposed anchoring locations and along the planned cable route for contaminants and heavy metals that may create environmental challenges;
- **Archaeological searches** including magnetometers and drop-cameras are recommended to detect any archaeological or cultural artifacts that require protection under local regulations;
- **Geotechnical testing** of shallow sediment cores is recommended to characterize the bottom substrate and the type and depth of surficial sediments. Testing should include conventional soil properties such as grain size, gradations and shear strengths, as well as testing such as strain rate effects, permeability (sands/silt), shell content, plasticity, compressibility and relative density for evaluation of trenchability.

Coastal engineering studies

- **Wind**: Site-specific measurements using a traditional anemometer supplemented with Light Ranging and Detection (LiDAR) or Sonic Detection and Ranging (SODAR)
- **Waves:** A full wave climate should be developed. Extreme value analysis and risk-based approaches should be employed to select representative events for further analysis and wave transformation. The measurement of waves near the detailed study areas through repurposing of inactive Gulf of Maine Ocean Observing System (GoMOOS) buoys is recommended to calibrate wave models to the local conditions. It is also recommended that the wave climate near the cable-landing site be determined for use in sediment transport modeling.

- **Water levels**: A desktop study of recorded water levels near the planned cable route is recommended. The understanding of the water level climate can be used in the calibration of hydrodynamic models and to understand the tidal currents.
- **Currents**: Tidal currents, wave-induced currents, and synoptic currents are important in the GoM. It is recommended that existing hydrodynamic models for the GoM be leveraged and the resolution improved near the project area, or new models be developed to gain a full understanding of the currents throughout the study area. Current measurements for calibration of the model(s) are highly recommended. A resolution sufficient to identify areas of strong or focused currents along the cable route should be employed.
- **Sediment transport**: A study of the baseline sediment transport conditions across the entire planned cable route is recommended. This includes identifications of dynamic features (ridges and shoals), as well as an assessment of longshore sediment transport and shoreline change near the cable landing area. Any areas that are particularly susceptible to scour can also be identified and appropriate measures recommended.

Environmental studies

- **Desktop studies**: Synthesis of known information on terrestrial, avian and marine resources including data from the Offshore Wind Energy Geographic Information System (OWEGIS), the Northeastern Regional Association of Coastal Ocean Observing Systems (NERACOOS) observational buoy network, ongoing regional environmental monitoring efforts, marine research universities and institutes, state and federal resources, and Maine Wind Industry Initiative (MWII) member organizations;
- **Delineation of natural resources** in the project area including freshwater wetlands, vernal pools, coastal wetlands, coastal marshland and essential fish habitat (EFH) areas in the vicinity of the construction/assembly area and along the subsea cable and transmission line route. As part of the identification of these resources, a Biological Assessment of potential impacts to federally-listed species and assessment of impacts to EFH-managed species should be completed;
- **Direct physical interaction – birds/bats**: As noted, radar ranges of less than or equal to two kilometers ($\leq$ 2 km) are needed to resolve individual passerines, and the need for a fixed or floating platform for radar will make pre-deployment data problematic to obtain. One adaptive management approach would be to use surveillance radar to detect and avoid flyways of large flocks, followed by studies after turbine deployment that mount radar units directly on the turbine platforms to evaluate individual bird trajectories and behaviors;
- **Habitat modification**: In terms of pelagic habitat modification, a before-after, control-impact (BACI) design is recommended to evaluate the impact of floating offshore wind platforms on pelagic fishes. Two sampling approaches should be

used concurrently – one based on mobile acoustic surveys with biological verification and the other based on continuous stationary acoustic monitoring. The system may also be able to monitor marine mammal use of the area, depending on system configuration, sampling rate, frequencies, beam angles, etc.;

- **Upwelling studies** including an upstream buoy and a downstream buoy to achieve time resolution, with glider observations taken at the onset of stratification, at peak stratification in summer and during the fall decay of stratification;
- **Macrofaunal effects**: Recommended sampling design would employ BACI methodology on four stations, with two stations located at random within the anchor footprint, one 500 m upstream in the Maine Coastal Current of the closest anchor and one 500 m downstream with an approximate minimum of three cores or grabs from each of the four stations;
- **Acoustic effects**: Using a BACI design, continuous stationary (active and passive) acoustic monitoring can be deployed in control and test sites at various distances to examine patterns in fish distributions as functions of environmental conditions (e.g., wind speed) and ambient noise levels; and
- **Electromagnetic Field effects**: A better ability to determine the need for and to design appropriate electromagnetic field (EMF) effect studies is anticipated after the Pacific Northwest National Laboratory (PNNL) completes additional current studies on animal sensitivity across a range of species. Possible electromagnetic field studies include field observations via remotely operated vehicles (ROVs) on American lobster behavior.