National Offshore Wind Research and Development Consortium
Program Opportunity Notice (PON) 4124
Up to $7,000,000 Available
NYSERDA reserves the right to extend and/or add funding to the Solicitation should other program funding sources become available

Proposal submissions accepted until December 31,2019 3:00PM EST or until all funds are committed.

Proposal Scoring Rounds will commence in May 2019 and continue monthly. Any, all, or none of the available funds may be committed in any Scoring Round.

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I. INTRODUCTION

In June 2018, the U.S. Department of Energy (DOE) announced the selection of the New York State Energy Research and Development Authority (NYSERDA), the Renewables Consulting Group (RCG), the Carbon Trust (CT), and the Advanced Energy Research and Technology Center (AERTC) at Stony Brook University to form a nationwide research and development consortium for the offshore wind industry. The National Offshore Wind Research and Development Consortium (“the Consortium”) is a nationally focused, independent, not-for-profit organization comprised of key offshore wind industry stakeholders and research institutions. The Consortium is dedicated to managing industry-prioritized research and development of offshore wind to maximize economic benefits for the United States. The U.S. DOE award is for $20.5 million, at least $2 million of which will directly fund U.S. federally-funded research and development centers (FFRDCs). This award will be matched by NYSERDA.

The Consortium seeks to fulfill, in part, a long-term vision for offshore wind in the United States that is supported by current policy for an all-inclusive energy strategy. To achieve this vision, the Consortium supports a strategy of identifying the technology innovations needed to address challenges and lower costs in each of the five U.S. offshore regions, allowing offshore wind to compete in all regional electricity markets without subsidies. The necessary cost reductions can be realized in part through targeted research and development (R&D) that removes or reduces technological and supply chain barriers to deployment and lowers development risk to investors. The Consortium envisions conducting this research as desktop studies, design development, and computer analysis, as well as hardware development with supporting demonstration and validation activities.

In November 2018 the Consortium released its initial Research and Development Roadmap (Roadmap) to advance offshore wind technology, drive wind technology innovation and combat climate change. Established in response to industry-led feedback, the Roadmap establishes a long-term vision for innovative offshore wind technology development in the United States and identifies key priorities for establishing the industry as a leading national clean energy sector.

Focusing on the research and development priorities identified in the Roadmap, available research funds will be distributed through a series of competitive solicitations over the next four years. These competitive solicitations will reflect the three Research Pillars described in the original U.S. DOE funding opportunity announcement (DOE FOA 1767):

Pillar #1: Offshore Wind Plant Technology Advancement

Pillar #2: Offshore Wind Power Resource and Physical Site Characterization

Pillar #3: Installation, Operations and Maintenance, and Supply Chain

This solicitation seeks proposals to address the specific Technical Challenge Areas outlined in Section II. Future revisions of this solicitation may add additional Challenge Areas, or update or remove existing ones. Proposals for research on topics other than those identified in Section II, as per the current revision of the Solicitation at the time the proposal is submitted, are not in scope for this solicitation and will be considered non-responsive.

NYSERDA and the Consortium intend to support projects with the best research organizations to achieve maximum impact. Proposals are welcomed from all geographic locations. It should be noted that, as a condition of the award, a waiver from the U.S. DOE will be required for any funded work that will be undertaken outside of the United States.

Proposal Submission: Proposers may submit multiple proposals provided that each proposal concerns a separate and distinct topic. Each individual proposal must be submitted as a single file, inclusive of all supporting documents. Online submission is preferred. Proposers may submit Word, Excel, or PDF files (file formats include: csv, doc, docx, gif, jpeg, jpg, pdf, png, ppt, pptx, pps, ppsx, tif, txt, xls, xlsx, and zip). Individual files should be 100MB or less in file size. Proposal PDFs should be searchable and should be created by direct conversion from MS Word, or other conversion utility. Files should not be scanned. For ease of identification, all electronic files must be named using the proposer's entity name in the title of the document. NYSERDA will also accept proposals by mail or hand-delivery if online submission is not possible. For detailed instructions on how to submit a proposal (online or paper submission), click the link "Application Instructions and Portal Training Guide [PDF] " located in the "Current Opportunities" section of NYSERDA's website (https://www.nyserda.ny.gov/Funding-Opportunities/Current-Funding-Opportunities.aspx).

No communication intended to influence this procurement is permitted. For technical questions about this proposal, contact Richard Bourgeois at (518) 862-1090, ext. 3484 or by email at nationaloffshorewind@nyserda.ny.gov or Scott Egbert, Program Manager at (518) 862-1090, ext. 3113 or by email at nationaloffshorewind@nyserda.ny.gov Questions regarding Attachments B2-B4 should be directed to Steve Wolk at (518) 862-1090, ext. 3021 or by email at nationaloffshorewind@nyserda.ny.gov

If you have contractual questions or questions about NYSERDA's processes and policies regarding this solicitation, contact Nancy Marucci at (518) 862-1090, ext. 3335 or by email at NancySolicitations@nyserda.ny.gov. Contacting anyone other than the Designated Contacts (either directly by the proposer or indirectly through a lobbyist or other person acting on the proposer's behalf) in an attempt to influence the procurement: (1) may result in a proposer being deemed a non-responsible offerer, and (2) may result in the proposer not being awarded a contract.

Scoring Rounds:

Proposals will be accepted at any time up until the due date noted above. During this period, several Scoring Rounds are anticipated. Scoring Rounds will occur approximately monthly, as proposals are received. Dates for the Scoring Rounds will not be published. NYSERDA reserves the right to change the interval of Scoring Rounds without notice or publication. **Any, all, or none of the available program funds may be awarded in any Scoring Round**: therefore, proposers are encouraged to submit as soon as their proposals are ready for review. Proposals not selected for award can be updated based on feedback and be resubmitted up to twice yearly.

* **All Proposals must be received by 3pm Eastern Time on the date noted above. Late, faxed, or emailed proposals will not be accepted.** Incomplete proposals may be subject to disqualification. It is the proposer's responsibility to ensure that all pages have been completed/included in the application. Please note: for online submission, there are required questions that you will have to answer in addition to uploading attachments and you should allot at least 60 minutes to enter/submit applications. The online application system closes promptly at 3pm, files in process or attempted edits or submission after 3pm Eastern Time on the date above, will not be accepted. If changes are made to this solicitation, notification will be posted on the "Current Opportunities" section of NYSERDA's website (https://www.nyserda.ny.gov/Funding-Opportunities/Current-Funding-Opportunities.aspx .

Guidance for Federally Funded Research and Development Centers (FFRDCs):

Federally Funded Research and Development Centers (FFRDCs), including but not limited to DOE national laboratories, are eligible to receive awards under this Solicitation as either a prime recipient or subrecipient. Except where noted below, all requirements for proposal submission and project execution apply equally to FFRDCs and to other applicants.

Proposals from or including FFRDCs will be evaluated and selected for award according to the procedures and criteria described in this Solicitation. No preference in evaluation and selection of awardees will be given to proposals from or including FFRDCs.

The DOE Wind Energy Technologies Office (WETO) will directly fund up to a total of $2 million of research activity at DOE/NNSA FFRDCs under their standardized Annual Operating Plan (AOP) procedures if those FFRDCs are selected by the Consortium as project awardees, whether as prime recipients or subrecipients. After the total of $2 million in direct funding by WETO has been reached, the Consortium may make additional awards to DOE/NNSA FFRDCs. However, FFRDC funding, in aggregate, may not exceed 25% of the total of DOE's and NYSERDA's funding for Consortium solicitations.

Whether the FFRDC is proposed as the prime recipient or as a subrecipient to another proposer, the appropriate authorization must be included in the proposal as a Letter of Support as follows:

- **Authorization for non-DOE/NNSA FFRDCs**

  The federal agency sponsoring the FFRDC must authorize in writing the use of the FFRDC on the proposed project and this authorization must be submitted with the proposal. The use of a FFRDC must be consistent with its authority under its award.

- **Authorization for DOE/NNSA FFRDCs**

    The cognizant Contracting Officer for the FFRDC must authorize in writing the use of the FFRDC on the proposed project and this authorization must be submitted with the proposal. The following wording is acceptable for this authorization:

    "Authorization is granted for the Laboratory to participate in the proposed project. The work proposed for the laboratory is consistent with or complementary to the missions of the laboratory and will not adversely impact execution of the DOE-assigned programs at the laboratory."

If a DOE/NNSA FFRDC is selected for award as a prime or subrecipient, during the contracting process the FFRDC must provide a DOE Field Work Proposal (FWP) in accordance with the requirements in DOE Order 412.1, Work Authorization System.

Either NYSERDA, if an FFRDC is the prime recipient, or the prime recipient, if an FFRDC is a subrecipient, will be the responsible authority regarding the settlement and satisfaction of all contractual and administrative issues including, but not limited to disputes and claims arising out of any agreement between the prime recipient and the FFRDC.

If an FFRDC is selected for award as a prime recipient and is funded directly by WETO, the FFRDC must still execute an agreement, such as a cooperative research and development agreement, with NYSERDA to arrange work structure, project execution schedule, and performance obligations. Similarly, an FFRDC selected for award as a subrecipient and funded directly by WETO must execute an appropriate agreement with the prime recipient pursuant to the FFRDC's designated role in the project.

Budget amounts proposed by or awarded to DOE/NNSA FFRDCs, even if funded directly by WETO, will count toward the budget limits for the funding categories given in Section II.

DOE/NNSA FFRDC representatives may direct their questions on the AOP process and format to Shane Beichner (shane.beichner@ee.doe.gov). All other inquiries should be directed to designated contacts listed for this Solicitation.

II. SOLICITATION TOPICS AND REQUIREMENTS

The following challenge area descriptions include examples of projects that would address the challenge as a guide for prospective proposers. Guidelines for quantifying the benefits of proposed projects to the U.S. offshore wind industry are also provided.

Proposals for research on topics other than the Challenge Areas described are not in scope for this solicitation and will be considered non-responsive. However, Challenge Areas may be added, deleted or modified in future revisions of this solicitation. Similarly, the Roadmap will be continually revised in response to research and commercialization results.

Construction of new research facilities or modification of existing facilities will not be funded under this solicitation. However, this solicitation may support research and equipment related to such facilities. For example, a reference site planning process, procurement of instrumentation, advancement of state-of-the-art instrumentation, establishment of data collection and reporting protocols that ensure relevance of results to industry and other stakeholders, and validation campaigns utilizing the reference site.

A. Priority Technical Challenge Areas for Pillar #1

Challenge Area 1: Array Performance and Control Optimization

Challenge Statement

To date, efforts to improve annual energy production and increase reliability have focused more on individual wind turbine refinement than on the challenges and rewards of operating multi-turbine arrays to perform most efficiently as fully integrated wind plants. As offshore turbines and projects grow larger, new plant-wide design approaches and control strategies are needed to optimize energy capture, minimize turbine downtime, and reduce overall cost, based on an enhanced understanding of wake characteristics, wind profiles, and other atmospheric conditions at U.S. offshore wind sites.

Objective

The main objective of this challenge is to enable wind plant performance optimization through development of new methods, tools, and designs based on technology innovation and computer modeling of advanced plant controls.

Background

Recent studies such as the FP7 Cluster Design project; ECN Far and Large Offshore Wind Farm program: Wind Farm Wake Modeling, Fatigue Loads and Control; the DOE's Atmosphere to Electrons (A2e) program; and Carbon Trust Wind Farm Control Trials; indicate array performance and control optimization can improve lifetime economic performance through increased power production and reduced O&M costs as well as extend the lifetime of the asset. Moreover, the pitch and yaw-based control strategy estimates could result in a combined 0.5-3.5% increase in energy yield, and therefore, impact levelized cost of energy reduction. Also, employing array optimization strategies could enable load reductions of up to 50% for certain wind turbine components, which will reduce fatigue and turbine maintenance and O&M costs (Carbon Trust, 2017).

Several studies have been undertaken to understand atmospheric conditions, wake characteristics, and their effects on energy production at European offshore wind sites and on U.S. land-based wind sites through the DOE's A2e program. However, there is a need to better understand the atmospheric conditions at all U.S. wind energy areas (Atlantic, Pacific, Gulf of Mexico, and Great Lakes), taking into account differences in the wind conditions between U.S. and European sites. Understanding these differences is important as it will lead to improving the atmospheric models used to predict offshore wind plant loads and performance in the U.S. and inform how wind plant performance could be impacted. As the number and size of offshore wind plants built in U.S. waters increases, such methods and tools are needed to improve the wind plant annual energy production, increase reliability, and reduce O&M costs.

Proposals in this area are expected to demonstrate innovations that can lead to higher wind plant output and/or lower plant operating costs in a comprehensive cost model that accounts for improvements. Indirect effects on the market and U.S. supply chain should also be described.

Example Project Types

The following list provides example project types that could address this challenge. This list is meant as a reference and is not intended to be exclusive. All project proposals will be considered provided they contribute to the objectives of addressing this Challenge Area.

- Model the performance and assess the physical behavior of ultra-large rotors (200+ meters) in a large-scale array, including examining possible behavioral deviations from current understandings (e.g., wake expansion ground/surface effects).
- Assess how best to optimize whole wind plant control systems to maximize energy capture for varying wind directions and atmospheric conditions found in U.S. wind energy areas.
- Assess the best approach to wake steering strategies to reduce intra-array turbulence and power losses within existing and future U.S. wind energy areas. For reference, the A2e program conducted similar studies for onshore wind plants (DOE, 2016).
- Enhance optimization methods by developing offshore wind models for ascertaining least-cost plant layouts, considering real-world site conditions such as siting restrictions due to fishing etc.
- Near-term solutions to refine layout planning.

Proposers are encouraged to seek inputs from, or partner with, equipment manufacturers and other members of the supply chain in order to maximize applicability to commercial offshore wind plants, as well as to provide insight on commercialization pathways for new technologies.

Additionally, to avoid duplication of effort and build on the overall state-of-the-art, proposals should seek opportunities to build on prior research efforts and leverage existing programs in wind plant optimization. One example relevant to this challenge area is the A2e program supported by the DOE, which seeks to reduce the cost of both land-based and offshore wind energy through an improved understanding of the complex physics governing electricity generation by wind plants.

Challenge Area 2: Cost-Reducing Turbine Support Structures for the U.S. Market

Challenge Statement

Fixed-bottom turbine support structure designs developed for Europe may not be optimal for the U.S. market due to differences in seabed characteristics, extreme weather conditions, environmental and regulatory constraints, available installation vessels, and maturity of the domestic supply chain. Technology solutions are needed to optimize monopiles, jackets, gravity-base, suction buckets, transition pieces and/or other types of foundation designs in order to lower overall cost and ensure suitability under the specific conditions of U.S. offshore wind regions.

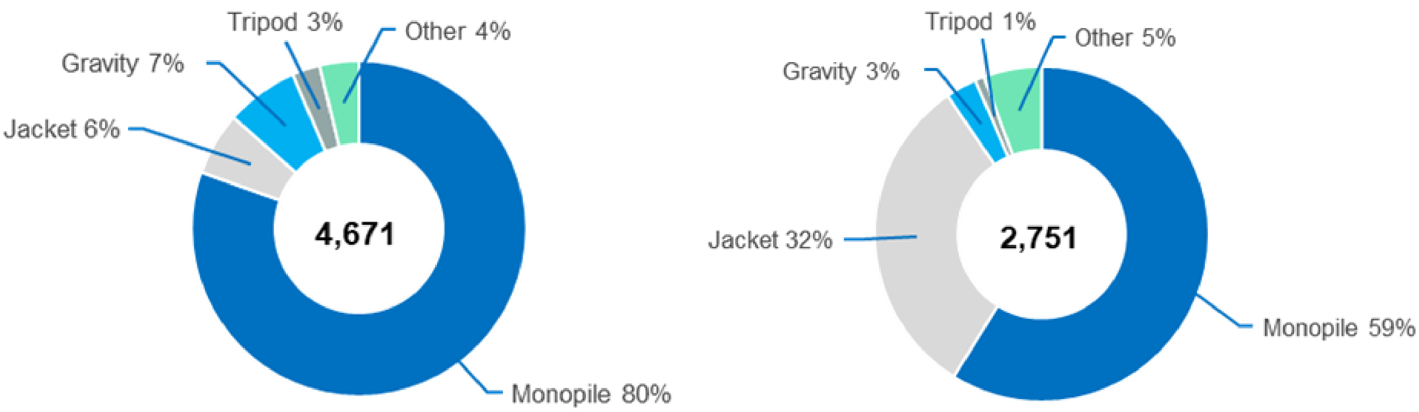
Objective

The main objective for this challenge is to develop fixed-bottom support structure design options (including transition piece designs) more suitable for U.S. site conditions and that facilitate the advancement of U.S. manufacturing capabilities relative to existing baseline designs. Design modifications will be proposed and evaluated, and new support structures designs will be identified to suit site conditions or enable support structure manufacturing within the U.S.

Background

Most offshore wind turbines installed to date are mounted on fixed-bottom substructures embedded into the seabed. This is largely due to the easy transferability of skills and knowledge from the oil and gas industry, as well as the relatively shallow water depths available for siting projects. With more than 40% of the U.S. offshore wind resource located in water depths of 60 meters or less, the use of fixed-bottom substructures is feasible in many U.S. offshore locations (DOE, 2017) and offers the best near-term solution for the initial U.S. offshore wind projects.

To date, monopiles make up the majority of installed offshore wind substructures in Europe. However, their dominance in the industry is decreasing as other substructures are better suited for some sites due to varying site conditions. In addition, alternative substructures may offer greater cost reductions in U.S. waters and may be more easily fabricated by the domestic supply chain. The Block Island offshore wind project off Rhode Island is one example where a jacket substructure was chosen in order to utilize U.S. fabricators in the Gulf of Mexico, reducing the overall cost of the wind plant.



Global fully commissioned offshore wind fleet by foundation type.

Global planned offshore wind fleet by foundation type.

Figure 1. Global Offshore Wind Fleet
Source: GRIP, The Renewables Consulting Group, 2018

Though there are several different sub-structure designs available, the market is predominantly dominated by three existing available designs: monopiles, jackets, and gravity-base, all designed and developed based on European offshore site conditions. Assessments of the suitability of existing available support structures targeted for U.S. specific conditions are needed. These assessments are encouraged to quantify, but are not limited to, the following variables:

- Support structure mass and cost scaling;
- Domestic installation capabilities;
- The development of calculation methods suitable for U.S. soils and seabed conditions;
- Domestic supply chain opportunities;
- Alternative installation methods to mitigate possible environmental impacts;
- Alternative installation methods to avoid negative cost impacts due to Jones Act restrictions;
- Extreme wind and wave resiliency; and
- Water depth.

In addition to assessing the suitability of existing designs for U.S. site conditions, there are a number of opportunities to develop innovative products or solutions that are more suited to U.S. conditions, supply chain and vessel availability. Such as:

- Innovative substructure designs or design modifications to existing substructures;
- Innovative materials used as an alternative to steel, such as advances in composite concrete, that are more cost effective, provide necessary strength, and supplied by U.S. manufacturers (Wind Power Engineering, 2018);
- Substructure solutions that reduce the dependency on foreign flagged or expensive heavy lift vessels;

- An innovative or optimized approach to fabricating substructures (e.g., increasing the modularity of a substructure) that will increase the efficiency of quayside fabrication; and
- Options that extend the lifetime of the substructure, delaying the need to decommission and reducing the overall levelized cost of energy.

As the offshore wind industry continues to develop, there is a great opportunity to innovate, modify, and optimize offshore substructures to match U.S. offshore conditions, manufactured and installed by U.S.-based companies.

Substructures and foundations account for 13.9% of the capital expenditure for a fixed-bottom offshore wind plant (NREL, 2016), and this percentage can vary significantly with water depth, bottom conditions, and the capability of the local supply chain. There is the potential for these projects to have a marked impact on reducing the capital expenditure for substructures and enable development at some sites where existing substructure technology is not feasible. However, large levelized cost of energy reductions may not be possible unless the innovation affects multiple areas of the cost breakdown structure such as installation and construction.

These projects will enable potential U.S. substructure suppliers to design and develop substructures that are better fit for purpose, without having to take on the entire design and development cost themselves, which could be prohibitive. These projects may also identify gaps in the supply chain that can help inform and focus wider domestic supply chain enabling activities such as use of existing facilities and indigenous materials.

Example Project Types

The following list provides example project types that could address this challenge. This list is meant as a reference and not intended to be exclusive. All project proposals will be considered provided they contribute to the objectives of addressing this Challenge Area. For the purpose of this challenge, the term “existing fixed-bottom substructures” refers to the transition piece, monopiles, jackets, gravity base, suction buckets, tripods, and tri-pile support structures only.

- Technical assessment of existing fixed-bottom support structures for suitability in U.S. offshore site conditions.
- Technical assessment of the types of modifications required to make existing support structures more suited to U.S. site conditions:
    - Likely overall cost implications of any modifications;
    - Ability to be installed without the use of a heavy-lift vessel;
    - Capability of U.S. supply chain to deliver modifications; or
    - Demonstrated ability to mitigate a technology barrier (e.g., difficult soils types) to deployment in the U.S.
- Supply chain gap analysis for manufacturing current fixed-bottom support structures;
- Innovative substructure designs or design modifications to existing substructures delivered by the U.S. supply chain;

- Innovative materials that can be used as an alternative to steel, such as advances in composite concrete, that are more cost effective, provide the necessary strength, and supplied by U.S. manufacturers;
- An innovative or optimized approach to fabricating substructures (e.g., increasing the modularity of a substructure) that will increase the efficiency of quay side fabrication; and
- Options that extend the lifetime of the substructure, delaying the need to decommission and reducing the overall levelized cost of energy

All prospective proposals for this challenge are encouraged to seek inputs from, or partner with an offshore wind developer, a U.S. offshore wind substructure supplier or include an advisory group comprising of developers and/or substructure suppliers to ensure the direction of the project and outcomes can be commercially applied. Additionally, proposals should identify research and/or partners who have been working on this challenge to demonstrate research will further the overall state-of-the-art.

Challenge Area 3: Floating Structure Mooring Concepts for Shallow and Deep Waters

Challenge Statement

Anchoring floating offshore wind systems in both shallow water depths (between 60 and 100m found off the U.S. Atlantic coast) and depths of 500 meters or more (Pacific Coast), poses design, installation, and cost challenges. Innovative mooring and anchoring technologies and methods are needed to manage loads on the substructure and anchors, incorporate alternative materials, optimize safety factors, and lower cost. Such innovations should consider potential impacts of increasing line spread, potential environmental and navigation impacts, and long-term performance. Based on factors such as varying water depth, seabed conditions, extreme wind and wave conditions, and seismic activity, the technology needs for floating wind mooring and anchoring systems will vary by region.

Objective

The main objective of this challenge is to identify new shallow and/or deep-water mooring concepts that are effective, easy to install, and lower technical risk. The impact of these projects will be to enable a greater number of potential development sites, as deployment at very deep or very shallow sites is presently perceived as expensive or high risk.

Background

Shallow Water Mooring Concepts
Current mooring systems (especially catenary mooring types) become more expensive at shallower water depths due to the need to avoid snap loading and anchor uplift forces; constrained watch circles; and the need to balance stiffer motion frequencies with wave excitation. Large platform motions in storms can cause localized tension spikes (snap loads) in mooring lines when a line re-engages after momentarily going slack (Hsu, 2017). Shallow water depths may also increase anchor loads and introduce unfavorable load vectors, requiring local seabed condition optimization. Alternative design

configurations and mooring solutions are needed to address shallow water issues, including load management solutions, optimized safety factors and new materials, without adding cost at sites representative of U.S. seabed conditions.

Deep Water Mooring Concepts
A steep drop of the continental shelf off the Pacific coast, combined with minimizing visual impact by locating projects far from shore, will likely lead to Pacific floating wind projects regularly being sited in water exceeding 500 m depth. Technology concepts are sought to demonstrate mooring and anchors system designs that assess the following:

- Practical floating wind system depth limits;
- Potential to exceed assumed practical limits (e.g., 1000 m maximum depth) for the Pacific coast and Hawaii;
- Mooring line spread requirements—how they scale with depth for the California and Hawaii;
- BOEM wind energy call areas, and how they can be optimized; and
- Optimized anchor designs and methods for installation in deep water and at sites prone to seismically induced soil liquefaction.

Whether optimized for shallow regions or deep-water conditions, new mooring concepts should demonstrate feasibility using dynamic mooring analysis for major International Electrotechnical Commission (IEC) design load cases and system cost models. Concepts should also comply with applicable recommended design, installation, and operations practices for floating systems in U.S. waters. Consideration will also be given to design concepts for any depth that minimize conflicts with existing offshore commercial and recreational activities and stakeholders, such as commercial fishing groups.

Mooring systems may include catenary spread moorings, tension leg moorings, or taut mooring systems, suitable for expected soil conditions or hybrid solutions. Proposed designs for optimized mooring systems may use novel line materials and configurations, potentially including components such as buoys, clump weights, and buoyant towers, with emphasis on components and installation methods that utilize U.S. suppliers and installers.

The global floating offshore wind supply chain is currently in its infancy; however, with the considerable expertise the U.S. already has through the oil and gas (O&G) sector, there is the opportunity for O&G suppliers to diversify to floating wind and become global offshore wind supply chain leaders. Furthermore, many of the proposed projects for this challenge will likely require some form of technical innovation. These projects will support the growth of the U.S. floating offshore wind supply chain by enabling domestic supply chain companies to benefit from these innovative mooring systems.

Example Project Types

The following list provides example project types that could address this challenge. This list is meant as a reference and not intended to be exclusive. All project proposals will be considered provided they contribute to the objectives of addressing this Challenge Area. All prospective proposals for this challenge are encouraged to seek inputs from, or partner with, a U.S. offshore wind substructure supplier or include an advisory group comprising of developers and/or substructure suppliers to ensure the direction of the project and outcomes can be commercially applied. Additionally, proposals should identify research and/or partners who have been working on this challenge to demonstrate that the research will further the overall state-of-the-art.

- New mooring designs to minimize cost and maximize performance for various platform types:
    - Designs optimized for use in shallow water;
    - Designs and methods to automate/expedite anchor and mooring line installation, including hook up, as well as solutions for lowering O&M costs by facilitating easy disconnect and reconnect of the platform from the mooring system;
    - Development and qualification of synthetic materials for applications specific to mooring systems; or
    - Tethering solutions incorporating springs, elastomers, and other specialized components for improved dynamic response within mooring systems.
- Anchor designs for challenging seabed conditions (e.g., rock);
- Technical studies of fatigue mechanisms in floating wind mooring systems for improved understanding of conditions leading to failure and facilitation of future system optimization;
- Development of loading, redundancy, and Operations & Maintenance (O&M) inspection concepts, strategies, and guidelines, appropriate to the offshore wind industry;
- Assess the potential for fluid soil/structure interaction dynamics to impact the stability limits (including seismic conditions);
- Assessment of the potential impact of mooring lines and electric array cables on fishing activity; and
- Possible mooring line and array cable design configurations that could reduce any identified potential impacts to fishing activity.

Challenge Area 4: Power System Design and Innovation

Challenge Statement

Rapid deployment of offshore wind in the U.S. will create significant technical challenges for utilities, developers, regulators, and policymakers seeking to introduce offshore wind with minimal grid disruption at the lowest possible cost. Power system technology solutions are needed to lower individual project cost, reduce transmission losses, and enable aggregation strategies that address potential integration problems.

Objective

The main objective for this challenge is to reduce the cost and/or risk of bringing electricity to land from an offshore wind plant and distributing it to the grid. Uncertainty around interconnection can raise contingencies and finance costs as well as make the array cabling more expensive.

Background

Transmission infrastructure typically accounts for 10–20% of offshore wind capital expenditure, of which 8–12% typically accounts for the cost of cable supply and installation. Lessons learned from European offshore wind plants have shown that cable related incidents account for 80% of insurance claims and approximately 60% relate directly to cable damage during construction (Carbon Trust, 2018). Typically, the design of the offshore wind transmission infrastructure is influenced by several factors (NREL, 2014): Site characteristics; for example, distance to shore, water depths, and seabed geology

- Number and type of wind turbines and related construction and maintenance operations/requirements;
- Turbine spacing and cable configuration;
- Reliability (dependent on many factors);
- Electrical line losses;
- Location of substation platform(s);
- The significant cost savings estimate of 5-6% of overall project cost can be achieved through advancements in transmission system design (NREL, 2014). These advancements may include the following:
    - Innovative power system simulation software tools that can be used for electrical/cabling system design for both offshore and onshore applications
    - Layout optimization assessment to minimize electrical losses
    - Innovative or modified inter-array cable designs that are more cost efficient
    - Innovative or modified export cable designs that are lighter and more cost efficient
    - Medium Voltage Direct Current (MVDC) wind turbines that eliminate the need for turbine mounted transformers

The criticality of the transmission infrastructure in connecting the offshore wind plant to the land-based grid means there is great motivation for continued improvement and optimization to limit risks, reduce the levelized cost of energy and increase reliability.

It is considered that power system projects will financially enable the U.S. supply chain to develop innovative electrical infrastructure that would have otherwise been cost-prohibitive for them to design on their own. Projects will also provide a clear vision on where the industry is focusing its efforts, and therefore, what technical trends the supply chain and regulators should focus on for future offshore wind electrical system advancement. As most of the equipment is currently imported to the U.S., there is a considerable opportunity for tier 1 suppliers to develop U.S. supply lines.

Example Project Types

The following list provides example project types that could address this challenge. This list is meant as a reference and not intended to be exclusive. All project proposals will be considered provided they contribute to the objectives of addressing this Challenge Area. All prospective proposals for this challenge are encouraged to seek inputs from, or partner with an offshore wind developer or include an advisory group comprising of developers to ensure the direction of the project and outcomes can be commercially applied. Additionally, proposals should identify research and/or partners who have been working on this challenge to demonstrate that the research will further the overall state-of-the-art.

- Technical assessment of the most critical power system infrastructure barriers or enablers to developing offshore wind;
- Innovative power system technologies/designs/architectures that lower individual project cost, reduce risks, reduce losses, or enable longer distance transmission through the application of

new power conversion systems, cable technology, or array power system technology that are fully tested and compliant with U.S. standards, such as:
  - Medium Voltage Direct Current (MVDC) dynamic cables;
  - MVDC breakers; or
  - High-voltage array cables.
- Technology solutions to reduce cost through the elimination of the offshore substation;
- Technology advances that lower cost and increase U.S. market availability of both turbine-to-turbine array cables and array-to-shore export cables; and
- Assessment of existing onshore grid systems, future requirements, and the potential upgrades needed to ensure uptake of large amounts of offshore wind power.

B. Priority Technical Challenge Areas for Pillar #2

Challenge Area 1: Comprehensive Wind Resource Assessment

Challenge Statement

Currently, the most comprehensive wind resource assessment of U.S. offshore territory is a 2016 assessment conducted by the National Renewable Energy Laboratory (NREL), with inputs from multiple models (NREL 2016). However, the assessment has several key limitations, and has not been fully validated against existing measured data. Further efforts at assessing the wind resource within the US exclusive economic zone are needed which better quantify the resource and its uncertainty at multiple heights where turbines operate, with a time-varying component, to enable more accurate modeling of power output, operational costs and grid integration.

Objective

The objective of this challenge is to update, improve and expand upon current U.S. offshore wind resource assessments in all regions where offshore wind may be deployed, using state-of-the-art meso-scale models with the best available input data and undertaking an assessment at multiple time scales to enable studies on resource adequacy, energy estimation and grid impacts.

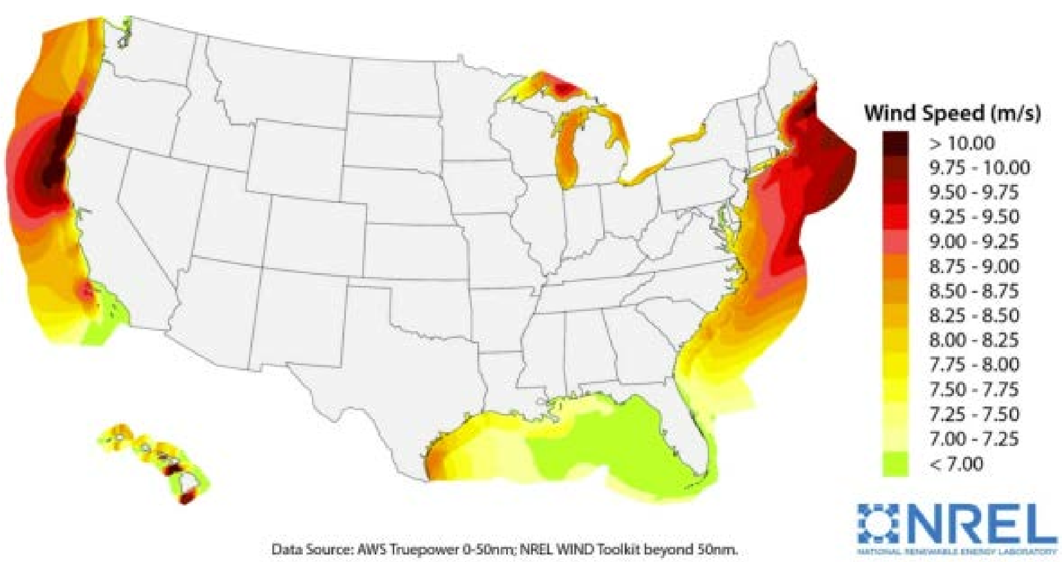
Background

Offshore wind geo-spatial resource assessments have been used by public and private entities alike to make major planning decisions that impact the U.S. offshore wind industry. Based on the relative lack of historical measured wind data offshore, as well as the time and expense associated with new on-site measurement campaigns, the industry frequently relies upon mesoscale models that are run with a variety of inputs, including, for example, reanalysis data and measured climate data (radiosonde, buoy, or land-based).

The most recent national offshore wind resource assessment of the outer continental shelf and Great Lakes was conducted in 2016 by NREL. However, there are some limitations to the data in that assessment that warrant a more comprehensive analysis. For example, the assessment relies on multiple modeled datasets corresponding to differing geographic areas, which have not been validated with actual in situ wind speed measurements at various hub heights.

In the continental United States, data from 0 to 50 nautical miles (nm) from shore utilize one dataset developed by AWS Truepower (now part of Underwriters Laboratories), while data from 50 to 200 nm from shore utilize another dataset, the Wind Integration National Dataset (WIND) Toolkit, developed by NREL. The AWS and WIND Toolkit datasets have considerably different model configurations; the AWS dataset relies on the Mesoscale Atmospheric Simulation System (MASS), developed internally by AWS several years ago, while the WIND Toolkit is based on simulations from the open-source Weather Research and Forecasting (WRF) mesoscale model, developed and maintained by the National Center for Atmospheric Research (NCAR). The AWS and WIND Toolkit datasets also differ considerably in their input data sources to the model (e.g., sea surface temperature boundary condition, elevation and land use datasets) and model physics (e.g., planetary boundary layer parameterization, radiation parameterization). These modeling differences have resulted in significant disparities between the two datasets over the entire US (land and sea) in their estimations of wind speed at all time scales, which can propagate to much larger uncertainties in downstream analyses such as life cycle cost of energy, capacity expansion, and grid integration.

A significant limitation is that the 2016 resource assessment is averaged over a typical meteorological year, but it does not provide a temporal component, which is necessary for proper characterization of the resource and grid integration factors. Furthermore, the primary map (see Figure below) presents wind speeds only at a hub height of 100 m, while future offshore wind turbines are expected to be erected with hub heights 120 m or higher, and with maximum tip heights exceeding 200 m. Finally, consideration could be given to the benefits of a higher spatial resolution, currently limited to a 2-by-2-km grid in the 2016 resource assessment, to allow for more in-depth planning.



2016 offshore wind resource map (Source: NREL)

The goal of this challenge is to increase the offshore wind resource assessment knowledge base specific to U.S. waters. The proposed projects will contribute to this broader goal by addressing elements of it, through updating the mesoscale analysis used in NREL's 2016 map as well as through other projects targeting the improvement of the knowledge base, using state-of-the-art technology and methods to help ensure all offshore wind potential in U.S. waters with is mapped, taking into account:

- Multiple heights to fit the scale of future wind turbine technology,
- Time-dependent aspects to aid in financial calculations and grid integration studies,
- A spatial resolution that allows for in-depth project development.

Example Project Types

With the aim of achieving the goal of this challenge, proposals are sought for an updated mesoscale analysis and map of the U.S. offshore wind resource, building on NREL 2016 data to incorporate more accurate datasets.

The following list provides example project types that could address this challenge. This list is meant as a reference and not intended to be exclusive. All project proposals will be considered provided they contribute to the objectives of addressing this Challenge Area. It is desired that project outputs will be compatible with each other, to the extent possible, to support building a common database; therefore, data should be provided in an appropriate and convenient format for public dissemination.

- New methodology to integrate multiple datasets including remote sensing and satellite input more seamlessly into a final composite wind resource model
- Improvement and development of meso-scale models using state-of-the-art technology
- Expansion of models to include multiple heights up to 200 m
- Inclusion of time-varying components in models and better uncertainty quantification.
- Studies on the trends of changing atmospheric conditions that may alter the available wind resource for an offshore wind project installed over the next decade, or research enabling those studies. Longer term research studies that help quantify potentially significant deviations from historical data and patterns shall also be considered. These studies may include science-based estimates of future changes to the frequency or severity of extreme events on a geo-spatial basis.
- Scientific studies to develop new methodology and validate model-based wind resource assessments using existing LIDAR field observations and surface buoys data.

Proposers are encouraged to seek inputs from, or partner with, an offshore wind developer in order to ensure maximum applicability to the development of commercial offshore wind plants. Additionally, proposals should identify partners who have been working in the area of this challenge to avoid redundancy and to ensure that the research will advance the overall state-of-the-art within the industry.

Challenge Area 2: Development of a Metocean Reference Site

Challenge Statement

Though the U.S. offshore wind industry is entering a period of rapid growth, there is still significant uncertainty relating to metocean conditions in the U.S. offshore environment. A significant part of the uncertainty is due to the lack of high-quality meteorological field observations in the regions where wind turbines may be deployed. This uncertainty has implications for system design, financing, and O&M strategies. As such, there's a critical need for metocean reference measurement stations at locations representative of future U.S. offshore wind sites, where high-quality, long-term measurements of various metocean quantities may be made and instruments used by U.S. offshore wind developers can be efficiently calibrated and verified. Though high-quality metocean datasets will have a multitude of applications, both within the wind industry and beyond, the reference station can help developers verify proper function of test equipment and validate on-site measurement systems deployed in offshore wind energy areas, both current and future.

Objective

The main objective of this challenge is to develop or advance a metocean reference site that can be used to test and validate regional wind resource observations and characterize new metocean measurement technology that is open to all industry parties.

Per the terms of the U.S. DOE cooperative agreement with NYSERDA, this Solicitation will not fund improvements to infrastructure or construction of new facilities. Projects that develop technology to enable and improve the collection of data using existing infrastructure, or projects leveraging infrastructure built using funds other than from this solicitation, will be considered.

Background

The US offshore wind industry is poised for rapid growth in the coming years, with multiple gigawatts under development and increasing areas of the U.S. outer continental shelf being identified as suitable for future developments. To realize the industry's full potential, accurate information is needed about the resource characteristics and external design conditions of both the atmospheric and subsea environments at heights and depths relevant to wind turbines and their associated structures. The community of users for such information spans nearly all aspects of the industry, including design, development, construction, operations, and financing, and spans all phases of project life, from pre-development to decommissioning.

In this context, the development of one or more metocean reference sites, akin to the FINO (Forschungsplattformen In Nord- und Ostsee) reference stations in northern Europe, is needed in an open ocean location representative of the existing BOEM Wind Energy Areas, in which innovative methods in wind resource observations and site characterization can be tested and validated. A complementary land-based reference station may also be needed where more detailed fixed met mast measurements can be conducted at higher elevations for ground-truth assessments. Technologies that are used to perform resource assessments, which may include improved floating and scanning LiDAR systems, large area scanning systems, remote temperature profiling, wave height measurements, SST, etc., need to be verified and validated against standard, vetted observations within a controlled reference test area. Transparent methods for assessing individual methods/sensors, open to the industry at large, are also needed, as are best practices and standards for ensuring that the quality and consistency of testing and validation practices meet the high standards necessary for building confidence in new technology and facilitating growth in a dynamic, capital-intensive market.

Although not the main mission of the reference site, long-term monitoring of oceanographic parameters for climate and weather modeling would benefit the industry and may have wider applications for other U.S. businesses that operate in the ocean environment.

Example Project Types

The following list provides example project types that could address this challenge. This list is meant as a reference and not intended to be exclusive. All project proposals will be considered provided they contribute to the objectives of addressing this Challenge Area.

- Development of an offshore and/or complementary land-based meteorological reference station that can be used for data collection, and for testing and validation of offshore wind instrumentation and data. A reference site should demonstrate the ability to reduce uncertainty in energy yield assessments for Wind Energy Areas and assess possible differences/similarities with northern European baseline records (e.g. FINO). Note that project award funding may not be applied for the construction or upgrade of facilities and infrastructure.
- Development of measurement systems or techniques for use in gathering and/or validating high-quality metocean data at an offshore and/or complementary land-based reference station. Measurements may be in relation to wind conditions, other atmospheric conditions, sea surface conditions, or subsea conditions.
- Development of best practices relating to the testing, validation and calibration of measurement systems against reference station measurements, for use at proposed or operational wind sites. Proposed best practices should be applicable to an existing or planned metocean reference station.
- Design of floating reference stations that may be deployed in deep water.

All prospective proposals for Challenge Area 2 are encouraged to seek inputs from, or partner with, any and all of the following: manufacturers of offshore wind turbines or substructures, offshore wind developers, certified verification agents, and turbine or substructure installers to ensure the project has maximum commercial applicability and benefit to the industry. Additionally, proposals should identify research that can be leveraged and/or partners who have been working on this challenge or are developing relevant infrastructure in order to demonstrate that the research will further the overall state-of-the-art and will be put into application for the benefit of the industry.

C. Priority Technical Challenge Areas for Pillar #3
Challenge Area 1: Heavy Lift Vessel Alternatives

Challenge Statement

Heavy lift vessels are generally used for all major offshore wind plant construction activities, including installing wind rotor nacelles and support structure components at the offshore site. Turbine growth trends indicate that turbines will continue to increase in power generation capacity and size, thus heavy lift vessels will be required to increase their lifting capacity at a commensurate pace. Larger vessels that can accommodate the increased turbine weight and tower height are continuously needed. However, weight lifting capacity and boom height tend to drive vessel costs up rapidly. Therefore, the ability to install ever-larger turbines may be limited if the lift capacity of available vessels cannot increase accordingly. The continuous upscaling of heavy lift vessels may not be the only, or the best, way to meet the installation requirements for ultra-large wind turbines that are expected to continue to grow in size over the next decade. This challenge area seeks to explore alternative methods for installing these large machines that best utilize existing U.S. infrastructure and remain within the constraints of the existing U.S. maritime laws, while simultaneously meeting the cost requirements of the offshore wind industry.

Objective

The main objective of this challenge is to develop alternative, innovative solutions for offshore heavy lift works such as new ship designs, the repurposing of existing U.S.-flagged vessels, or new, efficient lifting techniques for specific components. Vessel alternatives must be considered alongside turbine/foundation system design (fixed-bottom and floating) to enable cost-effective and efficient assembly and installation of ever larger wind turbines, in compliance with the Jones Act, and with the potential for deployment throughout the world.

Per the terms of the U.S. DOE cooperative agreement with NYSERDA, this Solicitation will not fund improvements to vessels or construction of new vessels. Projects that develop innovative vessel designs or alternative methodologies will be considered. Please refer to the Example Project Types for this Challenge Area for further guidance.

Background

To date the offshore wind industry has been deeply reliant on the use of heavy lift vessels that transport and install the heavier components of an offshore wind turbine (e.g. foundation, rotor nacelle, blades etc.) to an offshore wind plant. This is especially true in Europe where an increase in offshore wind development has led to a high demand and long lead time for adequate heavy lift vessels.

The Merchant Marine Act of 1920, also known as the Jones Act, requires that delivery of any goods between two ports in the United States be conducted by a U.S.-flagged, U.S.-built vessel. This generally restricts European vessels from being brought to the U.S. to support construction operations. At present there are no Jones Act compliant vessels capable of carrying out the heavy lifts necessary to install

current and future turbines, which require lifting heights greater than those previously encountered in the U.S. offshore oil and gas industry.
This challenge provides an opportunity to identify cost-effective alternative approaches to using heavy lift vessels, for both the U.S. and global markets.

Increased Turbine Capacity Challenges

As the wind industry pursues cost competitiveness through larger offshore turbines, the physical size of each component has grown rapidly. In March 2018, General Electric announced development of the 12 MW Haliade-X with 107 m blades, a rotor diameter of 220 m, and a blade tip height of 260 m, which is comparable in height to New York City's Chrysler Building. It is expected that other turbine manufacturers will soon follow with even larger capacity turbines. Industry projections foresee a turbine capacity range of 10-15 MW active on the market in the early 2020s. This development, while a positive step for the industry, comes with challenges associated with the construction and installation methodologies, presenting the need for new solutions to be designed, built to loadout and/or installed.

Some heavy lift vessel companies in Europe have used their experience with heavy lift operations in the oil and gas industry to transition to the wind industry, however the use of foreign-flagged vessels is extremely limited due to the Jones Act.

Jones Act Compliance

The Merchant Marine Act, 1920 (also known as the Jones Act) requires any vessel that is transporting merchandise between two points in the U.S. to be U.S. built, U.S.-flagged and U.S.-owned. As U.S. offshore wind plants are sited in U.S. waters, any vessel transporting components to or from an offshore wind plant would be required to comply with this act. Though there are a number of U.S. vessels that can support the construction of an offshore wind plant in U.S. waters, there is currently no Jones Act compliant heavy lift vessel with the capacity to install the heavier turbine components (e.g. the nacelle) at the heights required.

The lack of U.S. heavy lift vessels poses a challenge to development of offshore wind plants in the U.S. but also provides an opportunity for the industry to develop innovative approaches to installing offshore wind turbines that are compliant with the Jones Act.

The Block Island Wind Farm (5 x 6 MW turbines), the first U.S. offshore wind project, was built using a system of Jones Act compliant feeder barges which delivered the turbine components to a non-compliant European-flagged heavy lift vessel parked at the offshore site as a part of an assembly line-type system. As the number and size of turbines to be installed in the U.S. increase, more cost effective and innovative solutions will be needed. This is to not only manage heavier lifts, but also to manage the logistical implications of a longer project construction duration due to the increased number of turbines being installed.

Though Challenge Area 1 concerns heavy lift vessels, the requirement for Jones Act compliant vessels is not limited to installation vessels only. Other vessels involved in offshore project installation and operations include tugs and feeder barges, crew transfer, and service operations vessels, all of which need to be compliant and in sufficient number to meet the demand of the growing U.S. market.

Example Project Types

The following list provides example project types that could address this challenge. This list is meant as a reference and not intended to be exclusive. All project proposals will be considered provided they contribute to the objectives of addressing this Challenge Area. All prospective proposals for this challenge are encouraged to seek inputs from, or partner with an offshore wind developer, a U.S. offshore wind vessel operator or include an advisory group comprising of developers and/or vessel experts to ensure the direction of the project and outcomes can be commercially applied. Additionally, proposals should identify research that can be leveraged and/or partners who have been working on this challenge to demonstrate that the research will further the overall state-of-the-art.

- Technical assessment of existing Jones Act-compliant vessels, their suitability to serve the offshore wind industry, and potential modifications to repurpose for current and future wind turbine sizes,
    - Include design/redesign solutions, timelines for implementation, and detailed cost estimates;
- A new, innovative vessel design and/or installation approach to accommodate for current and future wind turbines sizes, for both fixed-bottom and floating turbine installations, in the U.S;
- Supply chain gap analysis for manufacturing wind-specific tools and equipment on installation vessels;
- Technical assessment of tools and equipment which will need to be upgraded on heavy lift installation vessels (blade yokes, x-frames, blade racks, etc.);
- Alternative, innovative heavy lifting installation methodologies including a corresponding Health & Safety plan to implement alongside these methodologies.

It is the intent of this Challenge Area to fund technical analyses and innovative design and engineering activities. Per the terms of the U.S. DOE cooperative agreement with NYSERDA, this Solicitation will not fund construction or adaptation of new vessels or infrastructure.

Challenge Area 2: Offshore Wind Digitization Through Advanced Analytics

Challenge Statement

With the number of offshore wind turbines installed in U.S. waters set to increase, system reliability is likely to become a growing concern. In an offshore environment, the cost of component damage/failure or operations and maintenance (O&M) is significantly more expensive to manage because accessibility and logistics are far more complicated. Managing these issues on a reactive basis has proven to be expensive and inefficient, however, with current advances in analytics and technology there is the opportunity through intelligent advanced data analysis to optimize O&M strategies, reducing the need for technicians to go offshore, and ultimately reduce the levelized cost of energy (LCOE).

Objective

The objective of this challenge is to optimize the installation and O&M phases of an offshore wind plant using advanced analytics, and component and system health monitoring technologies, to:

- Increase efficiency in both the installation and O&M phases (measured by possible metrics such as lower cost, decreased downtime, increased turbine availability, or increased energy capture);
- Achieve demonstrable reductions in component level damage and failures; and
- Reduce the labor hours spent offshore and the associated safety risk to personnel.

Per the terms of the U.S. DOE cooperative agreement with NYSERDA, this Solicitation will not fund improvements to infrastructure or construction of new facilities. Projects that develop technology to enable and improve the collection of data using existing infrastructure, or projects leveraging infrastructure built using funds other than from this solicitation, will be considered.

Background

At present there is a considerable amount of data being collected across offshore wind plants, mostly through turbine and plant level Supervisory Control and Data Acquisition (SCADA) systems. The SCADA system acts as a central 'nerve center' for the wind plant connecting individual turbines, the substation and meteorological stations to a central computer. SCADA systems are predominantly used to support analyses on the productivity of the wind plant and therefore focus primarily on collecting data to monitor the turbines' operating status, health condition, real-time and long-term performance, as well as efficiency (e.g. orientation, yaw, etc.).

In addition, comparatively little data is being collected to monitor the health of other components that make up the offshore wind plant, such as foundations and electrical cables etc., to assess damage or likelihood of failure. Issues on these components are usually identified during physical component inspections, (for which there is currently little guidance or industry standards) and may only be identified once the damage has progressed to a more serious (expensive) state.

One offshore wind industry trend has been to increase the number of remote sensors across the various offshore wind plant components to enhance the remote monitoring capabilities and to better identify, predict, and diagnose component damage and potential failures. The use of condition monitoring sensors on electrical cables is becoming more common practice as is the use of sensors on steel foundations to monitor the extent of internal corrosion. However, the use of these sensors is still limited, and data collected does not receive the proper level of analyses to enable it to inform O&M.

Furthermore, offshore wind developers are also starting to use remote monitoring sensors during installation to verify that all components have been installed correctly and that no damage occurred during construction. This is particularly true for cable installation since a large proportion of insurance claims on electric cables result from over bending or snagging during installation, causing damage to the internal conductors. Unfortunately, the development rate of new innovations in wind plant health prognostics, advanced analytical diagnostics, and new predictive maintenance strategies have not kept pace with the ever-increasing volumes of data being collected.

There is the opportunity to not only considerably improve and increase the technology used to capture component status data, but also develop a holistic integrated system that can collect, analyze, and interpret all component level data and make O&M decisions remotely. This would allow for fault detection during construction as well as facilitating better O&M planning leading to a more efficient maintenance process, reduced O&M cost and a reduced need for technicians going offshore.

As a world leader in advanced technology and analytics, the U.S. has the opportunity to combine this expertise with offshore wind knowledge to develop US-specific innovative approaches to reducing the cost and risk of offshore wind, through digitized advanced analytics.

Example Project Types

The following list provides example project types that could address this challenge. This list is meant as a reference and not intended to be exclusive. All project proposals will be considered provided they contribute to the objectives of addressing this Challenge Area.

Solutions are sought that can demonstrate increased reliability at component, system, turbine or plant level, and/or reduce at sea labor hours for O&M personnel on the U.S. fleet of offshore wind turbines.

Innovations under this topic may include:

- Remote repair capabilities featuring advanced sensors, artificial intelligence, and turbine-based robotics;
- Inspections using drones and autonomous vessels;
- Self-healing concepts to reduce manual repairs;
- Development of machine learning to facilitate lower cost offshore O&M;
- Demonstration and development of guidance on industry best practice for U.S. offshore wind component inspections;
- Increasing and improving the use of data analytics and big data management to increase offshore wind reliability;
- Condition monitoring sensor development for cables and sub-structures during installation and operation;
- Improving the understanding of asset lifetime integrity through advanced sensors;
- Better methodologies/technologies for assessing and mitigating marine environmental issues impacts in real-time;
- User friendly holistic integrated systems that can track the status of all major components and sub-systems in the wind plant to inform O&M planning.

All prospective proposals for this challenge are encouraged to seek inputs from, or partner with an offshore wind developer, a U.S. offshore wind component supplier, or include an advisory group comprising of developers and/or sub-structure suppliers to ensure the direction of the project and outcomes can be commercially applied. Additionally, proposals should identify research that can be leveraged and/or partners who have been working on this challenge to demonstrate that the research will further the overall state-of-the-art.

Challenge Area 3: Technology Solutions to Accelerate U.S. Supply Chain

Challenge Statement

Many of the components, subcomponents, and infrastructure for the initial phase of commercial offshore wind projects in the U.S. will be imported due to lack of qualified U.S. manufacturing and supply capabilities. This challenge area seeks projects to accelerate the maturation of the U.S. supply chain through technology solutions involving ports and harbor infrastructure, manufacturing sector growth, and enhanced marine operations capabilities. Successful projects will benefit developers, ratepayers, and state governments seeking economic growth and stability, and will bolster the U.S. manufacturing sector.

Objective

The objective of this challenge is to develop new technologies and concepts which can help to accelerate the U.S. supply chain towards the goal of promoting local content used in offshore wind plants. Successful concepts should result in increased utilization of existing U.S. manufacturing and new manufacturing (e.g. substructures that use the oil & gas supply chain, or an ultra-large locally manufactured blade etc.) that take advantage of local or regional manufacturing and assembly capabilities. Proposed projects need not be limited to existing design configurations but may offer collaborative innovations that introduce combinations of new materials, new strategies for deployment, and new advanced manufacturing methods that leapfrog current U.S. market constraints.

Background

As the U.S offshore wind market begins to take shape, one of the prevailing questions posed to the key manufacturers is, “When will offshore wind components be produced in the U.S.?”. With a growing pipeline of projects projected to be built along the Atlantic coast within the next decade and a lack of qualified U.S. manufacturing and supply capabilities, many of the components, subcomponents, and infrastructure for the initial phase of commercial wind projects in the U.S. will be imported. Moreover, there is an urgent need for fit-for purpose, U.S. flagged supporting vessels that are required as part of the wider construction and O&M fleet to enable the rapid development of offshore wind.

Proposed demonstration projects have relied on imported turbines, while Block Island Wind Farm was assembled using European-built turbines and a foreign-flagged installation vessel. However, the Block Island project has also shown the potential for U.S. produced and installed components, with steel jacket foundations having been supplied by fabricators from the Gulf of Mexico’s oil and gas industry. This is a good starting point for the U.S. offshore industry, proving that certain wind plant requirements can already be met by using the existing supply chain companies in the U.S. The open question to be addressed by manufacturers and support vessel operators is whether they can match the demand of the U.S. offshore project pipeline.

In order to answer the question of when more offshore components will be produced in the U.S., it is vital to determine how the U.S. supply chain can be accelerated to most effectively encourage investment in U.S. offshore wind manufacturing. Studies have indicated that factors such as infrastructure development, logistics optimization, and project timelines can all affect the degree to which local content that can be effectively incorporated into an offshore project. While the U.S. has a strong supply chain for the land-based wind industry, the translation to offshore is not an easy task as much of that competency is geographically located in the inland U.S. states rather than on the coasts, and the scale of components is much larger offshore. This poses logistical challenges for existing land-based manufacturing facilities seeking to transition to the offshore supply chain.

In terms of capital expenditures, turbines, support structures, and the electrical infrastructure account for the largest cost of an offshore wind plant and have the most reliance on the port and vessel capabilities. At present, U.S. port and vessel capabilities have not adapted to match the proposed pipeline of projects. The lack of Jones Act compliant heavy lift vessels (see Challenge Area 1), as well as the need for more fit-for-purpose construction and O&M support vessels, will drive future offshore wind projects to seek cost-effective alternatives.

Another vital part of U.S. supply chain development to enable U.S. offshore wind development will be to accelerate the training and growth of the domestic workforce. With the promise of numerous jobs along the eastern seaboard, training programs are being implemented throughout the region to prepare the American workforce for this new offshore frontier. This is an opportunity for researchers and developers to develop training centers and create new ways of training technicians (offshore, electrical, welders, etc.) and managers to master the execution and operation of an offshore wind turbine and do so in a safe and efficient manner. The use of technology can create new methods to train the workforce in ways that were not imaginable ten years ago.

Example Project Types

The following list provides example project types that could address this challenge. This list is meant as a reference and not intended to be exclusive. All project proposals will be considered provided they contribute to the objectives of addressing this Challenge Area. All prospective proposals for this challenge are encouraged to seek inputs from, or partner with an offshore wind developer, a U.S. offshore wind component supplier, or include an advisory group comprising of developers and/or sub-structure suppliers to ensure the direction of the project and outcomes can be commercially applied. Additionally, proposals should identify research that can be leveraged and/or partners who have been working on this challenge to demonstrate that the research will further the overall state-of-the-art. Analyses of the skill sets and/or tooling required to implement any proposed technology or method are welcome as part of the project in order to maximize the opportunity to increase the supply chain.

Projects under this Challenge area might include:

- Studies to assess current supply chain capabilities, limits and barriers to help identify gaps and likely bottlenecks in the first phase of U.S. offshore wind development. These studies should provide sufficient horizon planning to help inform longer term investments in infrastructure;
- Design of an innovative U.S.-focused standardized training program, in compliance with federal regulations, for offshore wind technicians or fabricators to build experienced local workforces;
- Development of unique teaching strategies to be utilized at planned offshore wind training centers;
- Support for the planning of a network of national offshore wind training centers;
- Redesign of a major wind plant component to utilize U.S. expertise and manufacturing competencies, and reduce costs;
- Development of a modularized component design that can be manufactured and installed using unique U.S. supply chain capabilities;
- Development of a lean manufacturing process for serial production of turbine components in order to reduce LCOE.
- Development and prototyping of innovative technologies and concepts, e.g. new vessel designs, that have potential to improve offshore construction and/or operations and Maintenance (O&M) logistics, while also supporting development of the U.S. supply chain.

It is the intent of this Challenge Area to fund technical analyses and innovative design and engineering activities. Per the terms of the U.S. DOE cooperative agreement with NYSERDA, this Solicitation will not fund construction or adaptation of new vessels or infrastructure.

D. References

American Meteorological Society – Offshore Wind Energy Committee, 2013. *The Need for Expanded Meteorological and Oceanographic Data to Support Resource Characterization and Design Condition Definition for Offshore Wind Power Projects in the United States.* [ONLINE] Available at: http://usmodcore.com/files/AMS_Offshore_Wind_APT_FinalReport_May2013.pdf. [Accessed 22 January 2019]

AWS Truepower, LLC, 2012, *Wind Resource Maps and Data: Methods and Validation*, [ONLINE] Available at: https://aws-dewi.ul.com/assets/Wind-Resource-Maps-and-Data-Methods-and-Validation1.pdf. [Accessed 17 January 2019]

AWS Truepower, LLC, 2012, *Description of the MesoMap System*, [ONLINE] Available at: https://aws-dewi.ul.com/assets/Description-of-the-MesoMap-System1.pdf. [Accessed 17 January 2019]

AWS Truepower, prepared for the U.S. Department of Energy, 2015. *Metocean Data Needs Assessment for U.S. Offshore Wind Energy.* [ONLINE] Available at: http://usmodcore.com//content/file/AWST_MetoceanDataNeedsAssessment_DOE_FinalReport_14Jan2015.pdf. [Accessed 22 January 2019]

Carbon Trust, Floating Wind Joint Industry Project, May 2018. Phase I Summary Report [ONLINE] Available at: https://www.carbontrust.com/media/675868/flw-jip-summaryreport-phase1.pdf. [Accessed 15 November 2018]

Carbon Trust, June 2015. Floating Offshore Wind: Market and Technology Review [ONLINE] Available at: https://www.carbontrust.com/media/670664/floating-offshore-wind-market-technology-review.pdf. [Accessed 15 November 2018]

Carbon Trust, Offshore Wind Accelerator, 2018. Cable Installation. [ONLINE] Available at: https://www.carbontrust.com/offshore-wind/owa/cables/. [Accessed 15 November 2018]

Carbon Trust, Offshore Wind Accelerator, 2018. Electrical Systems. [ONLINE] Available at: https://www.carbontrust.com/offshore-wind/owa/electrical/. [Accessed 15 November 2018]

Carbon Trust, 2017. Wind Farm Control Trials. [ONLINE] Available at: https://www.carbontrust.com/offshore-wind/owa/demonstration/wfct/. [Accessed 11 November 2018]

Carbon Trust, 2015, *Cable Burial Risk Assessment Methodology: Guidance for the Preparation of Cable Burial Depth of Lowering Specification.* [ONLINE] Available at: https://www.carbontrust.com/media/622265/cable-burial-risk-assessment-guidance.pdf [Accessed 12 March 2019]

Draxl, C. & Clifton, A. & Hodge, B & McCaa, J., 2015, *The Wind Integration National Dataset (WIND) Toolkit*, Applied Energy 151: 355-366, 10.1016/j.apenergy.2015.03.121.

Department of Energy, Atmosphere to Electrons [ONLINE] Available at https://a2e.energy.gov/. [Accessed 29 November 2018]

Department of Energy, Atmosphere to Electrons, 2016. Wake Steering Experiment. [ONLINE] Available at https://a2e.energy.gov/projects/wake. [Accessed 22 November 2018]

ECN, Far and Large Offshore Wind (FLOW) program, 2014. Wind Farm Wake Modelling, Fatigue Loads and Control. [ONLINE] Available at: http://www.flow-offshore.nl/page/wind-farm-wake-modelling-fatigue-loads-and-control. [Accessed 11 November 2018]

European Commission, FP7 Cluster Design, 2017. A tool box for offshore wind farm cluster designs. [ONLINE] Available at: https://cordis.europa.eu/project/rcn/101379/reporting/en. Accessed 11 November 2018]

General Electric, 2018, *Haliade-X Offshore Wind Turbine Platform.* [ONLINE] Available at: https://www.ge.com/renewableenergy/wind-energy/turbines/haliade-x-offshore-turbine [Accessed 12 December 2018]

Golightly, Chris, Future Offshore Foundations (conference paper), November 2017, Anchoring & Mooring for
Floating Offshore Wind. [ONLINE] Available at: https://www.researchgate.net/profile/Chris_Golightly/publication/321011241_Anchoring_Mooring_for_Floating_Offshore_Wind_Brussels_8th_November_2017/links/5a072405aca272ed279e52e5/Anchoring-Mooring-for-Floating-Offshore-Wind-Brussels-8th-November-2017.pdf. [Accessed 15 November 2018]

Hsu, Wei-ting, et al, Marine Structures, Vol. 55, Sep 2017. [ONLINE] Available at: https://www.sciencedirect.com/science/article/pii/S0951833917300886?via%3Dihub. [Accessed 15 November 2018]

HVPD, A subsea threat to the offshore renewable insurance market [ONLINE] Available at: https://www.hvpd.co.uk/files/3213/9455/6011/HVPD_-_Subsea_Threat_to_the_Offshore_Renewable_Insurance_Market.pdf [Accessed 26 February 2019]

National Offshore Wind Research and Development Consortium, 2018. Research and Development Roadmap, Initial Release Version 1.0. [ONLINE] Available at: https://www.nyserda.ny.gov/All%20Programs/Programs/Offshore%20Wind/Economic%20Opportunities/RD. [Accessed 30 November 2018]

National Renewable Energy Laboratory, 2015. Software Models Performance of Wind Plants. [ONLINE] Available at: https://www.nrel.gov/docs/fy15osti/63378.pdf. [Accessed 11 November 2018]

National Renewable Energy Laboratory. 2016. *2016 Offshore Wind Energy Resource Assessment for the United States.* [ONLINE] Available at: https://www.nrel.gov/docs/fy16osti/66599.pdf. [Accessed 17 January 2019]

National Renewable Energy Laboratory, 2017. Enabling the SMART Wind Power Plant of the Future Through Science-Based Innovation [ONLINE] Available at: https://www.nrel.gov/docs/fy17osti/68123.pdf. [Accessed 22 November 2018]

National Renewable Energy Laboratory, 2014. Offshore Wind Plant Electrical Systems. [ONLINE] Available at: https://www.boem.gov/NREL-Offshore-Wind-Plant-Electrical-Systems/ [Accessed 15 November 2018]

Navigant (prepared for U.S. Department of Energy), 2013, *U.S. offshore wind manufacturing and supply chain development.* [ONLINE] Available at:

https://www1.eere.energy.gov/wind/pdfs/us_offshore_wind_supply_chain_and_manufacturing_development.pdf [Accessed 01 March 2019]

New Energy Update, 2018, *Building the U.S. offshore wind supply chain: how do we do it?* [ONLINE] Available at: https://www.energycentral.com/system/files/ece/nodes/258443/supply_chain_paper_draft1.pdf [Accessed 22 February 2019]

NYSERDA, 2017, *U.S. Jones Act Compliant Offshore Wind Turbine Installation Vessel Study.* [ONLINE] Available at: https://www.nyserda.ny.gov/-/media/Files/Publications/Research/Biomass-Solar-Wind/Master-Plan/US-Jones-Act-Compliant-Offshore-Wind-Study.pdf [Accessed 12 December 2018]

Offshore Renewable Energy Catapult, 2017, *Offshore Wind Farm Substructure Monitoring And Inspection.* [ONLINE] Available at: https://ore.catapult.org.uk/app/uploads/2018/01/Offshore-wind-farm-substructure-monitoring-and-inspection-report-.pdf [Accessed 26 February 2019]

Offshore Wind Journal, *Cable incidents are largest cause of losses in offshore wind industry.* [ONLINE] Available at: https://www.owjonline.com/news/view,cable-incidents-are-largest-cause-of-losses-in-offshore-wind-industry_44199.htm [Accessed 26 February 2019]

Poulsen, T., and Lema, R., 2017, *Is the supply chain ready for the green transformation? The case of offshore wind logistics.* Renewable and Sustainable Energy Reviews 73: 758-771, https://doi.org/10.1016/j.rser.2017.01.181

Public Policy Center, UMass Dartmouth, 2018, *What will determine offshore wind supply chain development in the U.S.* [ONLINE] Available at: http://publicpolicycenter.org/osw_supplychain_factors/ [Accessed 22 February 2019]

U.S. Department of Energy, 2013, *Assessment of Vessel Requirements for the U.S. Offshore Wind Sector.* [ONLINE] Available at: https://www.energy.gov/sites/prod/files/2013/12/f5/assessment_vessel_requirements_US_offshore_wind_report.pdf [Accessed 12 December 2018]

U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, 2017. U.S. Conditions Drive Innovation in Offshore Wind Foundations. [ONLINE] Available at: https://www.energy.gov/eere/articles/us-conditions-drive-innovation-offshore-wind-foundations. [Accessed 12 November 2018]

Wind Power Engineering & Development, 2018. U.S. offshore wind industry needs improved foundations. [ONLINE] Available at: https://www.windpowerengineering.com/projects/offshore-wind/u-s-offshore-wind-industry-needs-improved-foundations/. [Accessed 12 November 2018]

Wind Energy The Facts, *SCADA and Instruments.* [ONLINE] Available at: https://www.wind-energy-the-facts.org/scada-and-instruments.html [Accessed 25 February 2019]

Wind Power Monthly, 2018. *Vessels Go Supersize.* [ONLINE] Available at: https://www.windpowermonthly.com/article/1465996/vessels-go-supersize [Accessed 12 December 2018]

E. Funding Categories

Three (3) categories of research will be considered for funding:

A. **Technical Feasibility Studies**: Category A is for feasibility studies that conduct preliminary research into the concepts underlying new products, systems, strategies or services as a first stage of development. These studies are necessary precursors to ultimate product development and commercialization. Feasibility studies may include conceptual design, technology and market assessments, and similar early-stage studies. Funding for projects in this category will be limited to $300,000. It is expected that all proposals will include a budget that is commensurate with the proposed project plan and proposers will justify their proposed budget in terms of reasonable costs and scope.

B. **New Product, Systems, Service or Strategy Development:** Category B includes efforts that are crucial to the development of a marketable product, system, strategy or service and any testing or validation of an innovation that is not already commercially available. Funding for projects in this category will be limited to $800,000. It is expected that all proposals will include a budget that is commensurate with the proposed project plan and proposers will justify their proposed budget in terms of reasonable costs and scope.

C. **Demonstration of Technologies, Systems or Services:** Category C is aimed at demonstrating and testing innovative offshore wind technologies, systems, strategies or services that have undergone product development and require testing to reach commercialization or are already commercially available but have not yet been sufficiently demonstrated in the U.S. to gain industry acceptance. This includes hardware, software, and market development initiatives. An example could be a new mooring concept that is in use in Europe but not yet demonstrated or sold in the U.S. Funding for projects in this category will be limited to $1,500,000. It is recognized that some demonstration projects, particularly large-scale demonstrations, may require additional funding. As such proposers are encouraged to seek additional funds, in-kind contributions or access to facilities from various offshore wind stakeholders. It is expected that all proposals will include a budget that is commensurate with the proposed project plan and proposers will justify their proposed budget in terms of reasonable costs and scope.

Proposers must select at least one (1) funding category per proposal, which must be indicated in the proposal. Proposals that do not identify a funding category may not be reviewed. If the funding category selected does not match the scope of the project, NYSERDA may at its discretion evaluate the project in terms of a category that in its determination better matches the proposed scope. If such a proposal receives is selected for award, it will be subject to the requirements of the funding category to which it has been assigned.

Multi-phase project proposals, i.e. a single project that spans more than one funding category, will be considered. For example, a proposed project may include Category B Product Development (Phase I) followed by a Category C Product Demonstration (Phase II). Each proposed project Phase must adhere to the requirements of the appropriate funding category for that Phase including required documentation and recommended maximum funding levels. NYSERDA may, at its discretion, select one or more phases for award without selecting other proposed phases. With respect to the proposal requirements (see Section III), multi-phase project proposals must submit all required attachments and fill out all required sections of the Proposal Forms for each phase per the instructions of Attachment B.

All multi-phase projects must include Go/No-Go decision points following each Phase. To proceed to the next phase the Contractor must demonstrate its progress in meeting the technical and commercial milestones of the prior Phase. The Contractor will not be permitted to proceed to the next Phase or submit invoices for work performed in that Phase without written approval, which may be granted or withheld at NYSERDA's sole discretion.

Similarly, Go/No-Go decision points will be required within each project Phase or at one or more points within a single-phase project, typically after each approximate $250,000 allotment of NYSERDA funding.

Project schedules must take into account a U.S. DOE Go/No-Go decision point at the beginning of each Budget Period, as follows:

Budget Period 1: from October 1 2018 to December 31 2019
Budget Period 2: from January 1 2020 to December 31 2020
Budget Period 3: from January 1 2021 to December 31 2021
Budget Period 4: from January 1 2022 to September 30 2025

If a DOE no-go decision is reached at the conclusion of a Budget Period, milestones complete prior to the no-go decision may be invoiced. Work completed after the no-go decision may not be invoiced. Milestones partially completed may be partially invoiced, with an allowable amount determined at NYSERDA's sole discretion.

The proposed Statement of Work is subject to negotiation and NYSERDA may offer to fund any of the proposal's phases therein at a lower level than that requested, such as by offering to fund a feasibility study rather than a proposed prototype development effort.

F. Project Requirements

Project Scope. To qualify for funding, proposals must:

- Address issues essential for cost reduction, deployment, and industry expansion specific to offshore regions of the U.S. Proposals offering research topics already being addressed by other international projects, must explain why further research is necessary.
- Adhere to the challenges identified in Section II of this solicitation. Although the Technical Challenges and Roadmap will be updated in the future, it is expected the Consortium will continue to maintain an industry-focused, prioritized offshore wind R&D agenda that enables early U.S. offshore wind project development, LCOE reduction, and geographic industry expansion beyond the currently designated Wind Energy Areas.

- Provide benefits to multiple end users. R&D projects that benefit multiple end users are expected to have a greater impact toward achieving the Consortium's industry-wide cost reduction targets compared to R&D projects focused on a developer's specific commercial offshore wind project.

Project Schedule, Phasing and Teaming. The following guidelines should be considered when developing proposals:

- Projects are expected to begin as soon as is feasibly possible with a project schedule estimate of: 6 – 18 months for Category A; 18 - 30 months for Category B; and Category C will be negotiated based on the scope and goals of the project.
- Teaming Agreements which include an end user such as an offshore wind developer or a key member of the offshore wind supply chain are strongly encouraged, to enhance the likelihood of successful commercialization. Teams may include offshore wind developers, turbine manufacturers, supply chain members, research organizations, universities, national laboratories, end-users, or other stakeholders.

- Proposals must state the existing Technology Readiness Level (TRL) of any technology being proposed and what the expected TRL of that technology will be at the end of the proposed project, as a direct result of having undertaken the project. See Attachment B3, Technology and Commercialization Readiness Level Calculator.

Project Benefit Quantification. The following guidelines should be considered when developing proposals:

<u>The potential impact on LCOE and Offshore Risks</u>

All proposals should provide an explanation of how the proposed project will impact the levelized cost of energy (LCOE), component level cost reduction or offshore risks and an estimation of when the impact on LCOE will be achieved. Explanations should consider the overall positive effect on reducing the cost of energy or risk rather than focus on any one component of levelized cost of energy to the detriment of others. For example, a proposal that reduces capital cost may increase risk and negatively impact the ability to finance offshore wind development projects.

Where relevant, all proposals should provide an explanation on how the project may impact risks and costs associated with health and safety. Projects that seek to reduce health and safety risks should clearly describe and wherever possible quantify the direct and indirect positive effects of the project on these risks.

It is expected that all LCOE calculations will be justified with evidence and analysis. Any estimates considered to be unrealistic or overly optimistic may be amended or disregarded. The below methodology provides a high-level approach to calculating LCOE. For consistency, it is recommended that all proposers use this approach.

<u>High level methodology to calculating LCOE</u>

One of the most common metrics for judging the benefit of a specific innovation or technical advancement is to calculate its impact on the levelized cost of energy. The levelized cost of electricity

(LCOE) is the net present value of the unit-cost of electricity over the lifetime of a generating asset. Proposers should implement the following equation to estimate the LCOE impact:

$$LCOE = \frac{(FCR \times CapEx) + OpEx}{AEP_{net}}$$

where:

FCR = fixed charge rate (%)
CapEx = capital expenditures ($/kW)
OpEx = average annual operational expenditures ($/kW/year)
AEP_{net} = net average annual energy production (kWh/year).

The Fixed Charge Rate (FCR) represents the annual revenue per dollar of investment required to pay the carrying charges on that investment, which include finances charges, incomes taxes, inflation and depreciation[1]. To ensure consistency of financial assumptions among project proposals, a real FCR of 6% should be assumed by applicants in their LCOE calculations.

Innovations that have the greatest impact could affect multiple elements of the LCOE equation. Other innovations may implement a higher cost component that will be offset by greater benefits in another area. For example, an advanced control system may increase turbine cost but may enable higher capacity factors that decrease LCOE by large amount. As part of the LCOE analysis, proposers should specify which cost elements are affected how they are affected and by what percentage they increase or decrease. Highest scoring proposals will provide thorough analysis to demonstrate the cost reduction potential and when the cost reduction is likely to be achieved.

[1] Further information on FCR and LCOE calculations in general may be found here: www.nrel.gov/docs/fy18osti/72167.pdf

Positive Impacts on the Supply Chain

All proposals shall provide an explanation on how the proposed project could have a positive impact on advancing the U.S. offshore wind supply chain. It is understood that some projects may not have a direct impact on the U.S. supply chain, in this case a description of indirect impacts resulting from the proposed project is encouraged.

Commercialization Strategy

All proposals will be required to include a summary and explanation of foreseeable follow-on efforts that will be required to enable the commercial use of the results obtained from that project in offshore wind plants in the U.S. All proposals for an innovative or modified technology/ methodology are required to provide a commercialization plan that details the expected path to commercialization or how the innovation will enable commercialization, and the necessary milestones in achieving this.

Although an award may support certain stages of commercialization, there should not be an expectation that NYSERDA or Consortium funding will support all stages required to reach commercialization. Any proposal for innovative designs, methods, or advanced systems must ensure they are compliant with U.S. regulations and best practices and may require further engineering effort, component and system validation testing, or infield demonstrations.

It is recognized that for some projects, considerable stakeholder engagement may be required to achieve the desired dissemination and utilization of results. Proposals will be encouraged to highlight where industry buy-in is needed, who the key stakeholders are, and provide a brief summary of how this industry integration could be achieved.

Timeframe for applying the results/technology

All proposals will be encouraged to provide a Gantt Chart indicating the expected time frame to complete the proposed scope of work, and where relevant, the expected time frame to reach technology commercialization. This should include a high-level breakdown of the time required to undertake follow-on tasks to reach commercialization. It is recognized that the time frame to apply the results from a project depends on the type of project being proposed; however, proposals are encouraged that maximize project outputs in a highly efficient timeframe and can be quickly adopted by the U.S. offshore wind industry.

Letters of Commitment or Interest.

If relying on any other organization to provide data, conduct a portion of the work, provide services, equipment or facilities, or contribute funds, a letter from that organization describing its planned participation and financial commitment must be included. In particular, if the project is dependent on data being provided by an offshore wind developer(s), a letter of commitment from the developers must be provided clearly describing how the data will be used and for what purposes.

Also include letters of interest or commitment from businesses or other organizations critical to the future commercialization, demonstration, or implementation of the project. This is especially critical when partnering with an offshore wind developer or offshore wind supply chain members.

Absence of letters of commitment or interest may be interpreted as meaning that the proposer does not have support from the subject parties. Project award will be contingent on the proposer securing the relevant committed data, work, services, equipment, facilities or funds as required by the project.

III. PROPOSAL REQUIREMENTS

Incomplete proposals may be subject to disqualification. It is the proposer's responsibility to ensure that all pages have been included in the proposal.

The proposer must submit a proposal using the instructions and attachments listed below. The goal should be to concisely present the information needed to fully address the Proposal Evaluation Criteria (Section IV). Proposals that exceed the word limits or fail to follow the format guidelines will be rejected as non-responsive. If you believe proprietary or confidential information must be submitted to provide an adequate proposal, please clearly indicate in your proposal which information is proprietary and confidential and mark that information accordingly. Attachments beyond those requested will not be considered.

Each page of the proposal should state the name of the proposer, the PON number, and the page number. All proposers are required to submit, at minimum, the following documents:

- Attachment A: Proposal Narrative (with required attachments)
- Attachment B1: Statement of Work
- Attachment C1: Milestone Payment Schedule
- Attachment C2: DOE Sub-Recipient Budget Justification

Instructions for all attachments are provided in the Attachment A Proposal Narrative file

Required sections of the Proposal Narrative differ according to the Funding Category being proposed. Additional attachments may also be required based on the proposed Funding Category or Categories.

Funding Category A
- Executive Summary
- Problem Statement and Proposed Solution
- State of Research and Technology Targets
- TRL/CRL Calculator (Attachment B3)
- Feasibility Study Information
- Statement of Work (Attachment B1) and Schedule
- Project Benefits
- Budget
- Proposer Qualifications
- Letters of Commitment
- Attachments

Funding Category B

- Executive Summary
- Problem Statement and Proposed Solution
- Business Model Canvas (Attachment B2)
- State of Research and Technology Targets
- TRL/CRL Calculator (Attachment B3)
- Commercialization Potential of Proposed Solution
- Three-Year Financial Projections Worksheet (Attachment B4)
- Demonstration Site and Product (for projects that include pilot or validation testing ONLY)
- Replication Potential of Proposed Demonstration (for projects that include pilot or validation testing ONLY)
- Statement of Work (Attachment B1) and Schedule
- Project Benefits
- Budget
- Proposer Qualifications
- Letters of Commitment
- Attachments

Funding Category C

- Executive Summary
- Problem Statement and Proposed Solution
- Business Model Canvas (Attachment B2)
- State of Research
- TRL/CRL Calculator (Attachment B3)
- Commercialization Potential of Proposed Solution
- Three-Year Financial Projections Worksheet (Attachment B4)
- Demonstration Site and Product
- Replication Potential of Proposed Demonstration
- Statement of Work (Attachment B1) and Schedule
- Project Benefits
- Budget
- Proposer Qualifications
- Letters of Commitment
- Attachments

Proposers must carefully review the Attachment A, Proposal Narrative to ensure that all required sections and attachments are submitted. Failure to do so may result in the proposal being rejected as non-responsive.

A. Cost-Sharing

Proposers are not required to provide any form of cost-share; however, it is recognized that for projects such as demonstration projects, project team members may wish to provide additional funding or in-kind contribution to maximize the benefit of the project. Proposers are encouraged to provide an indication of any additional funding or in-kind contribution that will be used to support the delivery of a project.

B. Compliance with New York State Finance Law

In compliance with Sections 139-j and 139-k of the New York State Finance Law , proposers will be required to answer questions during proposal submission, which will include disclosing any Prior Findings of Non-Responsibility.

C. Annual Metrics Reports

If awarded, the proposer will be required to submit to NYSERDA on an annual basis, a prepared analysis and summary of metrics addressing the anticipated energy, environmental and economic benefits that are realized by the project. All estimates shall reference credible sources and estimating procedures, and all assumptions shall be documented. Reporting shall commence the first calendar year after the contract is executed. Reports shall be submitted by January 31st for the previous calendar years' activities (i.e. reporting period). The Contractor shall provide metrics in accordance with a web-based form, which will be distributed by NYSERDA. NYSERDA may decline to contract with awardees that are delinquent with respect to metrics reporting for any previous or active NYSERDA agreement.

IV. PROPOSAL EVALUATION CRITERIA

Proposals that meet solicitation requirements will be reviewed by a Scoring Committee using the following evaluation criteria:

A. Project Benefits and Value

All assumptions must be supported and justified using sources and evidence. For additional information see **Project Benefit Quantification**, Section IIC.

- The proposed solution has potential to significantly reduce LCOE. Components of LCOE include capital costs, operating costs and financing cost. Solutions that increase annual energy production without a commensurate increase in cost will also reduce LCOE.
- The proposed solution addresses a core technical barrier that is not being addressed by others and has the potential for wide-scale replicability.
- The proposed solution will bring economic benefits to the U.S. offshore wind industry in the form of manufacturing capability, supply chain development or technical services. U.S. jobs are expected to be created and/or retained as a result of this project.
- The proposed solution quantifiably lowers development risk and/or represents an enabling technology likely to increase offshore wind deployment in the U.S.
- Timeframes for the offshore wind industry to realize the benefits of the proposed solution are realistic and appropriate.
- The implementation strategy is well-conceived, appropriate for the current stage of development, and there is a sound plan for measuring progress and success.
- The proposed project scope is sufficient to deliver significant benefits. Where necessary and appropriate, the proposer has secured a commitment for additional cost share.
- The proposer exhibits strong market demand for this solution and has already identified one or more commercialization partners.

B. Innovation, State of the Art and Technical Merit

- The proposal identifies a problem fully aligned and essential to the advancement of one of the identified Technical Challenge Areas.
- The proposer has demonstrated insightful understanding of the current state-of-the-art relative to the Challenge Area.
- The proposed project is technically sound, feasible, innovative, and superior to alternatives, and will make significant progress toward solving the identified problem.
- The proposed approach and scope of work are aimed at developing and commercializing a technology, as opposed to basic research and discovery.
- Technical assertions, such as assessments of performance relative to the state-of-the-art, are verified by rigorous analysis.
- The proposal demonstrates industry buy-in and validation of the proposed technical concept.

C. Project Plan, Scope, Risks and Challenges

- The proposed project plan is clearly defined, with fully developed tasks, subtasks, milestones and deliverables that will enable effective project management.
- The scope of work is fully appropriate to the selected problem and will be highly valuable towards meeting the goals of the Technical Challenge Area and the Roadmap.
- Technical and programmatic risks are clearly understood and fully disclosed, with well-considered mitigation plans that have a high probability of ensuring project success.

- The cost of the project is strongly justified with respect to the expected benefits and the potential market or deployment opportunity.
- The proposal outlines a detailed plan for pursuing additional funding and development support, if necessary, to bring the proposed solution to full commercialization.
- The proposed work can be accomplished within the amount of time, effort, and resources proposed.
- The selected Funding Category is appropriate for the proposed solution.
- The proposal provides letters of commitment from all outside organizations the proposal team will need to provide data, equipment, support, facilities etc.
- The implementation strategy is well-conceived and appropriate for the current stage of development, with a sound plan for measuring progress and success.
- The proposal offers a compelling explanation of how it will address barriers to market entry and commercialization.
- The proposed plan as efficient as possible with regards to resources and time.

D. Team Experience and Capabilities

- The proposed team has the necessary expertise and resources to carry out the proposed work.
- The project team includes members with industrial and business experience as well as technical skill.
- The proposer has successfully commercialized one or more products or deployed services.
- The proposer has secured strong commitments from all essential team members and partners, including letters and has demonstrated strong support from necessary market actors.
- The proposal clearly demonstrates the team structure and staff responsibilities.
- For demonstration projects relying on entities and jurisdictional authorities such as a maritime agency, leaseholder, equipment manufacturer, etc., the project team has secured or has a plan to secure all the commitments necessary to execute the proposed project scope.

Program Scoring

Each proposal will be scored on a scale of 100 with the following weighting applied to each of the evaluation criteria:

1) Project Benefits and Value – 40%
2) Innovation and State of the Art – 30%
3) Project Plan, Scope, Risks and Challenges – 15%
4) Team Experience and Capabilities – 15%

Additional data or material to support applications/proposals may be requested. Proposers may also be requested to interview with all or part of the Scoring Committee to address any questions or provide clarification regarding information outlined in the proposals. Proposers will be notified if they are requested to participate in an interview.

Program Policy Evaluation Factors

NYSERDA reserves the right to accept or reject proposals based on the following factor(s):

1) Whether the proposed project will accelerate technology advances in areas that industry by itself is not likely to undertake.

2) The degree to which the proposed project optimizes the use of available funding to achieve programmatic objectives.
3) The degree to which the proposal expands the geographic diversity of the Consortium R&D efforts.
4) The degree to which the proposal expands the technical portfolio of the Consortium.
5) The degree to which the proposed project has leveraged award funds to expand their project scope and value attained with non-award resources.
6) The degree to which there are technical, market, organizational and/or environmental risks associated with the projects that outweigh the potential benefits.
7) Past performance of the proposer on other projects with NYSERDA, the US DOE, and Consortium member companies.
8) The degree to which project expenses are in line with market rates.

Awardees are expected to be notified within approximately 4-8 weeks from proposal submission if your proposal has been selected to receive an award, contingent upon successful execution of an award contract.

V. GENERAL CONDITIONS

A. Proprietary Information

Careful consideration should be given before confidential information is submitted to NYSERDA as part of your proposal. Review should include whether it is critical for evaluating a proposal, and whether general, non-confidential information, may be adequate for review purposes.

The NYS Freedom of Information Law, Public Officers law, Article 6, provides for public access to information NYSERDA possesses. Public Officers Law, Section 87(2)(d) provides for exceptions to disclosure for records or portions thereof that "are trade secrets or are submitted to an agency by a commercial enterprise or derived from information obtained from a commercial enterprise and which if disclosed would cause substantial injury to the competitive position of the subject enterprise." Information submitted to NYSERDA that the proposer wishes to have treated as proprietary, and confidential trade secret information, should be identified and labeled "Confidential" or "Proprietary" on each page at the time of disclosure. This information should include a written request to except it from disclosure, including a written statement of the reasons why the information should be excepted. See Public Officers Law, Section 89(5) and the procedures set forth in 21 NYCRR Part 501 https://www.nyserda.ny.gov/About/-/media/Files/About/Contact/NYSERDA-Regulations.ashx. However, NYSERDA cannot guarantee the confidentiality of any information submitted.

B. Omnibus Procurement Act of 1992

It is the policy of New York State to maximize opportunities for the participation of New York State business enterprises, including minority- and women-owned business enterprises, as bidders, subcontractors, and suppliers on its procurement Agreements.

Information on the availability of New York subcontractors and suppliers is available from:

Empire State Development
Division for Small Business
625 Broadway
Albany, NY 12207

A directory of certified minority- and women-owned business enterprises is available from:

Empire State Development
Minority and Women's Business Development Division
625 Broadway
Albany, NY 12207

C. State Finance Law sections 139-j and 139-k

NYSERDA is required to comply with State Finance Law sections 139-j and 139-k. These provisions contain procurement lobbying requirements which can be found at https://online.ogs.ny.gov/legal/lobbyinglawfaq/default.aspx . Proposers are required to answer questions during proposal submission, which will include making required certification under the State Finance Law and to disclose any Prior Findings of Non-Responsibility (this includes a disclosure statement regarding whether the proposer has been found non-responsible under section 139-j of the State Finance Law within the previous four years).

D. Tax Law Section 5-a

NYSERDA is required to comply with the provisions of Tax Law Section 5-a, which requires a prospective contractor, prior to entering an agreement with NYSERDA having a value in excess of $100,000, to certify to the Department of Taxation and Finance (the "Department") whether the contractor, its affiliates, its subcontractors and the affiliates of its subcontractors have registered with the Department to collect New York State and local sales and compensating use taxes. The Department has created a form to allow a prospective contractor to readily make such certification. See, ST-220-TD (available at http://www.tax.ny.gov/pdf/current_forms/st/st220td_fill_in.pdf). Prior to contracting with NYSERDA, the prospective contractor must also certify to NYSERDA whether it has filed such certification with the Department.
The Department has created a second form that must be completed by a prospective contractor prior to contacting and filed with NYSERDA. See, ST-220-CA (available at http://www.tax.ny.gov/pdf/current_forms/st/st220ca_fill_in.pdf). The Department has developed guidance for contractors which is available at http://www.tax.ny.gov/pdf/publications/sales/pub223.pdf .

E. Contract Award

NYSERDA anticipates making multiple awards under this solicitation. NYSERDA anticipates a contract duration of one to three years, unless NYSERDA management determines a different structure is more efficient based upon proposals received. A contract may be awarded based on initial applications without discussion, or following limited discussion or negotiations pertaining to the Statement of Work. Each application should be submitted using the most favorable cost and technical terms. NYSERDA may request additional data or material to support applications. NYSERDA will use the Attachment D, Sample Agreement to contract successful proposals. NYSERDA may at its discretion elect to extend and/or add funds to any project funded through this solicitation. NYSERDA reserves the right to limit any negotiations to exceptions to standard terms and conditions in the Sample Agreement to those specifically identified in the checklist questions. Proposers should keep in mind that acceptance of all standard terms and conditions will generally result in a more expedited contracting process. NYSERDA expects to notify proposers in approximately four to eight weeks from the receipt of a proposal whether your proposal has been selected to receive an award. NYSERDA may decline to contract with awardees that are delinquent with respect to any obligation under any previous or active NYSERDA agreement.

F. Accessibility Requirements

If awardees from this solicitation will be posting anything on the web, or if the awardee will produce a final report that NYSERDA will post to the web, the following language must be included. NYSERDA requires contractors producing content intended to be posted to the Web to adhere to New York State's Accessibility Policy. This includes, but is not limited to, deliverables such as: documents (PDF, Microsoft Word, Microsoft Excel, etc.), audio (.mp3, .wav, etc.), video (.mp4, .mpg, .avi, etc.), graphics (.jpg, .png, etc.), web pages (.html, .aspx, etc.), and other multimedia and streaming media content. For more information, see NYSERDA's Accessibility Requirements.

G. Limitation

This solicitation does not commit NYSERDA to award a contract, pay any costs incurred in preparing a proposal, or to procure or contract for services or supplies. NYSERDA reserves the right to accept or reject any or all proposals received, to negotiate with all qualified sources, or to cancel in part or in its entirety the solicitation when it is in NYSERDA's best interest. NYSERDA reserves the right to reject proposals based on the nature and number of any exceptions taken to the standard terms and conditions of the Sample Agreement. NYSERDA reserves the right to disqualify proposers based upon the results of a background check into publicly available information and the presence of a material possibility of any reputational or legal risk in making of the award.

H. Disclosure Requirement

The proposer shall disclose any indictment for any alleged felony, or any conviction for a felony within the past five years, under the laws of the United States or any state or territory of the United States and shall describe circumstances for each. When a proposer is an association, partnership, corporation, or other organization, this disclosure requirement includes the organization and its officers, partners, and directors or members of any similarly governing body. If an indictment or conviction should come to the attention of NYSERDA after the award of a contract, NYSERDA may exercise its stop-work right pending further investigation or terminate the agreement; the contractor may be subject to penalties for violation of any law which may apply in the particular circumstances. Proposers must also disclose if they have ever been debarred or suspended by any agency of the U.S. Government or the New York State Department of Labor.

I. Vendor Assurance of No Conflict of Interest or Detrimental Effect

The proposer shall disclose any existing or contemplated relationship with any other person or entity, including any known relationships with any member, shareholders of 5% or more, parent, subsidiary, or affiliated firm, which would constitute an actual or potential conflict of interest or appearance of impropriety, relating to other clients/customers of the proposer or former officers and employees of NYSERDA, in connection with proposer’s rendering services as proposed. If a conflict does or might exist, please describe how your company would eliminate or prevent it. Indicate what procedures will be followed to detect, notify NYSERDA of, and resolve any such conflicts.

The proposer must disclose whether it, or any of its members, or, to the best of its knowledge, shareholders of 5% or more, parents, affiliates, or subsidiaries, have been the subject of any investigation or disciplinary action by the New York State Commission on Public Integrity or its predecessor State entities (collectively, “Commission”), and if so, a brief description must be included indicating how any matter before the Commission was resolved or whether it remains unresolved.

J. Public Officers Law

For any resulting awards, the Contractor and its subcontractors shall not engage any person who is, or has been at any time, in the employ of the State to perform services in violation of the provisions of the New York Public Officers Law, other laws applicable to the service of State employees, and the rules, regulations, opinions, guidelines or policies promulgated or issued by the New York State Joint Commission on Public Ethics, or its predecessors (collectively, the “Ethics Requirements”). Proposers are reminded of the following Public Officers Law provision: contractors, consultants, vendors, and subcontractors may hire former NYSERDA employees. However, as a general rule and in accordance with New York Public Officers Law, former employees of NYSERDA may neither appear nor practice before NYSERDA, nor receive compensation for services rendered on a matter before NYSERDA, for a period of two years following their separation from NYSERDA service. In addition, former NYSERDA employees are subject to a "lifetime bar" from appearing before any state agency or authority or receiving compensation for services regarding any transaction in which they personally participated, or which was under their active consideration during their tenure with NYSERDA.

Any awardee will be required to certify that all of its employees, as well as employees of any subcontractor, whose subcontract is valued at $100,000 or more who are former employees of the State and who are assigned to perform services under the resulting contract, shall be assigned in accordance with all Ethics Requirements. During the term of any agreement, no person who is employed by the contractor or its subcontractors and who is disqualified from providing services under the contract pursuant to any Ethics Requirements may share in any net revenues of the contractor or its subcontractors derived from the contract. NYSERDA may request that contractors provide it with whatever information the State deems appropriate about each such person's engagement, work cooperatively with the State to solicit advice from the New York State Joint Commission on Public Ethics, and, if deemed appropriate by the State, instruct any such person to seek the opinion of the New York State Joint Commission on Public Ethics. NYSERDA shall have the right to withdraw or withhold approval of any subcontractor if utilizing such subcontractor for any work performed would be in conflict with any of the Ethics Requirements. NYSERDA shall have the right to terminate any contract at any time if any work performed is in conflict with any of the Ethics Requirements.

VI. ATTACHMENTS

Attachment A – Form-Fillable Proposal Narrative
Attachment B1 – Statement of Work Sample Format
Attachment B2 – Business Model Canvas Template
Attachment B3 – Technology and Commercialization Readiness Level Calculator
Attachment B4 – Three-Year Financial Projections Worksheet
Attachment C1 – Milestone Payment Schedule
Attachment C2 – DOE Sub-Recipient Budget Justification
Attachment D – Sample Agreement