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Scoping Commentary - Draft Research Concept on Advance to Next-Generation Offshore Wind Energy Technology

Additional submitted attachment is included below.

Memo

To:	California Energy Commission (CEC) Research and Development Division		
From:	David Aqui	Email:	david.aqui@atkinsglobal.com
Date:	November 13, 2020	Phone:	713-576-8541
Ref:	CEC Docket #: 19-ERDD-01	cc:	Bob Harrell
Subject:	Draft Research Concept on Advance to Next-Generation Offshore Wind Energy Technology Scoping Commentary		

1. Commentary Note

The California Energy Commission (CEC) research and development effort is essential to meet the state's energy targets. This memorandum provides commentary in response to the CEC's Draft Proposed Research and Questions for stakeholders and Floating Offshore Wind (FOSW) sector[1]. Text in this memo in *teal italics* has been extracted from the *Draft Research Concept on Advance to Next-Generation Offshore Wind Energy Technology*.

2. Preamble

Energy production and consumption is part of a complex energy system that enabled the industrial age. It has advanced along the way, how we transport and consume hydrocarbons, reduce emissions. Science has also revealed the impact of our reliance on the combustion of fossil fuels in the shape of greenhouse gases (GHGs) and its impact on the climate. Reduction can only be achieved by consuming and burning fewer fossil fuels despite this energy source proving to be the most potent, storable, and accessible form of energy. The absolute reduction of GHGs will not be immediate but at least it can stymie growth.

This energy system is being compromised to shift energy production away from fossil fuels to other carbon-free sources. This compromise has been recognized and embraced by most oil and gas operator majors and is evident in their dramatic transition to become integrated energy companies. Adjacent industries are unwitting stakeholders within the energy system and may be imposed to compromise. One that has been grabbing headlines is the consumer: the general public. California is already mandating consumers shift from internal combustion engines to electric cars. Another will be maritime, most prominent in the form of commercial fishing and national security off the west coast.

Commercial fishing is very much within the purview of community and state agency influence. Disruption and/or displacement of fishing is likely to be immediate or near-term. National security is not within a

1 Palma-Rojas, Silvia. 2020. Draft Research Concept on Advance to Next-Generation Offshore Wind Energy Technology. California Energy Commission. Docket Number: 19-ERDD-01. https://efiling.energy.ca.gov/getdocument.aspx?tn=235191

state's sphere of influence and has become a significant impediment to enabling offshore wind in California.

The Department of Defense (DOD) is responsible for managing and providing national security. Their requirements are a high priority but also needs to be balanced with the energy system. It is understandable if this cannot be evaluated in the public domain, but it certainly deserves attention, perhaps at a congressional level. It requires resources allocated to support a considered evaluation of DOD requirements against Department of Energy and Department of the Interior requirements. The national security impediment has split the state and has resulted in studies congregating around the north coast area[2].

3. Draft Proposed Research

3.1. Background

3.1.1. Introduction

The draft proposed research was informed by previous studies as follows and are discussed in corresponding sections:

- Research and Development Opportunities for Offshore Wind Energy in California[3] (Section 3.1.2)
- Utility-Scale Renewable Energy Generation Technology Roadmap[4] (Section 3.1.3)
- Cost of Floating Offshore Wind Energy Using New England Aqua Ventus Concrete Semisubmersible Technology[5] (Section 3.1.4)
- Forecasting Wind Energy Costs and Cost Drivers[6] (Section 3.1.5)

3.1.2. Research and Development Opportunities for Offshore Wind Energy in California

Research, Development, and Demonstration Recommendations (RD&D) were developed in three broad categories: technology and infrastructure research; environment and resource research; and other. Recommendations in the first two categories align with the mission of the CEC's Energy Research and Development Division. The recommendations are presented and discussed below.

3.1.2.1. Technology and Infrastructure Research Recommendations

1. Expand and advance technologies for mooring, cabling, and anchoring

Agreed. Innovative mooring system configurations and components could become significant to reducing overall LCOE through the wider use of synthetic mooring lines. Platforms that can utilize existing or modified manufacturing and 'assembly line' infrastructure would be advantageous for the local economy and job market as well as helping to scale floating wind. Comprehensive port infrastructure studies are

2 Schatz Energy Research Center. 2020. Offshore wind study series. http://schatzcenter.org/wind/

3 Sathe, Amul, Andrea Romano, Bruce Hamilton, Debyani Ghosh, Garrett Parzygnot (Guidehouse). 2020. Research and Development Opportunities for Offshore Wind Energy in California. California Energy Commission. Publication Number: CEC-500-2020-053. https://ww2.energy.ca.gov/2020publications/CEC-500-2020-053/CEC-500-2020-053.pdf

4 Schwartz, Harrison, Sabine Brueske. 2020. Utility-Scale Renewable Energy Generation Technology Roadmap. California Energy Commission. Publication Number: CEC-500-2020-062. https://ww2.energy.ca.gov/2020publications/CEC-500-2020-062/CEC-500-2020-062.pdf

5 Walter Musial, Philipp Beiter, and Jake Nunemaker. 2020. Cost of Floating Offshore Wind Energy Using New England Aqua Ventus Concrete Semisubmersible Technology. https://www.nrel.gov/docs/fy20osti/75618.pdf

6 Wiser, Ryan; et al. Forecasting Wind Energy Costs and Cost Drivers. 2016. DOE Contract No. DE AC02-05CH11231. https://emp.lbl.gov/sites/all/files/lbnl-1005717.pdf

required but needs to be inclusive for operations & maintenance (O&M), fabrication (hull and other offshore wind components), marshalling, storage, assembly and integration.

2. Develop technologies to ease operation and maintenance in extreme wind and wave conditions, including remote monitoring and robotic maintenance

Agreed. Most studies do not appear to be tackling the subject of personnel transfer for O&M. This could be very specialist.

3. Develop technical solutions to integrate offshore wind to the grid, including facilitating technologies like green hydrogen and subsea storage

Agreed. Within the domain of CEC and considered a high priority.

4. Develop approaches to use and optimize existing supply chain and manufacturing or assembly solutions in California

Agreed. Within the domain of CEC and considered a high priority.

5. Study the seismic vulnerability of floating platform mooring and anchoring systems

Agreed.

3.1.2.2. Environment and Resource Research Recommendations

7. Conduct additional wind resource studies offshore of California

Agreed.

8. Develop technologies to reduce wildlife impacts, including smart curtailment and deterrence

Agreed.

9. Expand state-led environmental studies along the California coast to fill gaps in existing research

Agreed.

3.1.2.3. Other Research Recommendations

10. Assess the offshore wind installed capacity that complements solar generation and is feasible

Agreed.

11. Conduct a comprehensive study on the total value proposition of offshore wind development, including grid and macroeconomic benefits

Agreed. Technical resolutions are on the right trajectory and further work needs to be undertaken as described in Section 2.

3.1.3. Utility-Scale Renewable Energy Generation Technology Roadmap

Recommended initiatives for offshore wind were identified as follows:

- *Initiative OSW.1: Develop and Demonstrate Floating Offshore Platform Manufacturing Approaches*
- *Initiative OSW.2: Develop Innovative Solutions for Port Infrastructure Readiness for OSW Deployment*
- *Initiative OSW.3: Develop Solutions for Integrating Wave Energy Systems with Floating Offshore Platforms*

Initiative OSW.1 and OSW.2 are universal and are consistent with initiatives identified at the national level[7].

7 National Offshore Wind Research and Development Consortium (NOWRDC). 2019. Research and Development Roadmap. Version 2.0. https://mk0pesafogiyof6m7hn7.kinstacdn.com/wp-content/uploads/2019/12/National-Offshore-Wind-Research-and-Development-Consortium-Roadmap-2.0.pdf

Initiative OSW.3 could benefit from further investigation. Due to the complexity of both wind energy conversion and wave energy conversion a pragmatic approach would be to further develop wave energy conversion independently before integrating into a hybrid dual energy conversion system.

3.1.4. Cost of Floating Offshore Wind Energy Using New England Aqua Ventus Concrete Semisubmersible Technology

The relevant takeaway in the context of CEC R&DD seems to be associated with the draft of the platform and stability to enable quayside turbine integration with the hull. This can largely be addressed through port and onshore infrastructure studies which, apart from considering onshore bearing capacity, should also include air draft data. These studies would identify suitable ports for supporting a floating wind supply chain as well as identify areas for improvement or modification for the ports and supply chain.

3.1.5. Forecasting Wind Energy Costs and Cost Drivers

This report identifies five Technology, Market, and Other Changes that can significantly reduce LCOE by 2030 as follows:

1. *Foundation / support structure design*
2. *Installation process efficiencies*
3. *Foundation / support structure manufacturing*
4. *Economies of scale via project sizing*
5. *Installation / transport equipment*

Item 1 foundation / support structure design improvements are well established by technology providers, although it could be argued the FOWT design basis would need to be updated based on items 2 and 3. There is scope to enhance installation process efficiencies and optimize foundation / support structure manufacturing. Port and supply chain studies would inform these refinements. The outcome of these improvements could require modifications to the foundation / support structure design.

Item 4 is somewhat beyond the sphere of influence of CEC and could be better addressed by BOEM through bringing offshore wind resources to the market via the size and number of wind energy areas. It will also rely on the ability of sizable projects to interconnect into the grid.

Item 5 covers both installation and transport. Optimizing installation and transport could trigger similar design feedback loops as for items 2 and 3 into item 1.

3.2. Proposed Project Objectives

1. Innovate manufacturing/assembly processes and materials for FOSW component(s) (e.g. substructure, foundation and support substructure) and demonstrate at a pilot scale to validate the expected benefits, such as LCOE reduction and increase the understanding of potential environmental and wildlife impacts of FOSW projects.

Meaningful pilot scale demonstrations will require BOEM approval. Is this being addressed?

Underwriting pilot scale demonstrations are likely to require more than the proposed Potential Project Budget to make the demonstration viable. Innovation at the component level may be feasible to demonstrate but could be a challenge to quantify LCOE reduction for evaluation by the CEC. A prequalification phase that supports applicants' project development and quantification might be beneficial.

2. Test and validate a monitoring system for FOSW applications that support reduction of installation and O&M costs and increase commercial readiness.

Testing and validation of installation and O&M is nice in principle but could be premature. Extensive studies could be more appropriate as this could inform design basis for FOSW packages and development.

3. Develop tools or methods for assessing and monitoring the environmental impacts (e.g. on marine biodiversity or habitat, currents and upwelling) related to manufacturing/assembly processes and operation of FOSW component(s).

This is valuable. We seem to be lacking a commercial impact assessment (competing with other maritime users).

4. Build a consortium that works on the development of parallel solutions for technical and environmental challenges that facilitate the deployment of cost-effective and environmental-friendly FOSW projects in California.

This is valuable; administration of the RD&D as well as within the RD&D projects.

4. Questions for stakeholders and FOSW sector

1. Which key research areas were not (fully) addressed in the draft research concept, but should be taken into consideration?

The following key research areas are put forward for further consideration:

A. The wind industry continues to see wind turbine capacity increases. Onshore wind turbine capacity was leveling off due to onshore transportation limitations of one-piece turbine blade construction (from tip to root). Offshore wind turbines are not restricted by blade length which has enabled a capacity race in offshore wind turbines. The pace is being determined by the wind turbine original equipment manufacturers (OEMs), capacity of heavy lift installation vessels and pile hammer sizes for the prevalent monopile substructures. Floating wind turbine platforms are not bound by these constraints but do rely on the aspirations of the turbine OEMs. This could enable wind turbine capacities far greater than have come to market to date. Along with this shift, the performance requirements that have enabled upwind horizontal axis wind turbines (HAWT) to be the dominant wind energy converters, both onshore and on offshore bottom-fixed substructures, could be disrupted and may need to be reevaluated. This could reintroduce the viability of downwind HAWT variants, vertical axis wind turbines (VAWTs) as well as triggering a departure from the industry standard wind turbine towers.

B. *Forecasting Wind Energy Costs and Cost Drivers*[6] identified transportation and installation equipment as one of the five Technology, Market, and Other Changes that can significantly reduce LCOE. It does not seem to share the same level of emphasis by the CEC although it does appear to be interwoven in some of the *Technology and Infrastructure Research Recommendations* such as *Develop technologies to ease operation and maintenance* and *Develop approaches to use and optimize existing supply chain and manufacturing or assembly solutions in California*. Logistics associated around transportation and installation to reduce offshore time, such as by replacing offshore time with onshore time, could be amplified as a specific area to be sponsored by the CEC.

2. What type of innovation is needed in design and material science that support the improvement of substructure and foundation components?

Mooring systems from hull connection through to seabed could benefit from more emphasis. Deepwater technology has been developed and proven for oil and gas facilities. Significant innovation will be required to enable utility scale technologies for California in water depths that exceed development taking place in the rest of the world.

3. Floating substructures have been demonstrated outside California's environment and context; what are the R&D opportunities to reduce costs of floating substructures for potential projects in California?

Floating substructures around the world are having to develop mooring systems for relatively shallow waters compared to the water depths where mooring systems have been proven. The innovation challenge for California is to develop effective and efficient mooring systems for offshore wind application, rather than offshore oil and gas operations which has higher station keeping requirements (to avoid environmental release and to enable well workover operations).

4. What type of innovation is needed in design and material science that supports the improvement of inter-array and export cables?

Evaluate the feasibility of suspended inter-array cables (i.e. not supported on the seabed). Determine water depth at which point it becomes economically feasible. Evaluate in terms of techno-economic feasibility as well as maritime impact.

5. What environmental studies are needed to complement current studies and support the deployment of FOSW in California? Please provide details.

Environmental studies that consider commercial fishing would be useful to determine potential impact to species both to climate change (e.g. species migration) and to proposed offshore wind developments (e.g. spawning). This could complement the socio-economic impact of offshore wind against potential deterioration due to rising sea temperatures.

6. What would be the appropriate level of project funding that would leverage private investments associated with the research proposed in this draft concept.

Private investors are probably limited to well-funded technology developers / providers, prospective offshore wind developers, and engineering procurement construction / installation (EPC/EPCI) contractors. There may be too much uncertainty for EPCs / EPCIs at this stage for the west coast; particularly when we see contracts lapsing with turbine original equipment manufacturers on the east coast as well as projects being delayed. Offshore wind developers are likely to have other priorities and leave the technical innovation to the technology developer / provider. Their solutions are evaluated first on technology readiness level and then in development / LCOE models. Technology developers are mostly interested in advancing the technology readiness level (TRL) of their design deferring the actual LCOE validation until much later in the design evolution at which point the design configuration is pretty much locked in.

There could be practical application for metocean and environmental buoys where LCOE is not a feature. Obtaining site characterization data could be of interest to offshore wind developers or could be sponsored by BOEM and recovered from lease awards.

7. CEC-funded studies have recommended research projects on alternative transmission paths, such as green hydrogen production and energy storage, that avoid costly transmission upgrades in the short time. What type of research project you identify as a critical to facilitate the deployment of alternative transmission paths in California?

The wind energy areas being explored by BOEM appear to be practicable in the north where there are no national security conflicts, unfortunately there are transmission deficiencies. CEC could address these more thoroughly.

Load balancing by blending intermittent renewables with storage and longer-term transmission could be beneficial and could have an immediate impact on brownouts. Evaluating existing infrastructure and different scenarios for a transition to renewables to achieve California's targets would be complementary to FOSW in California.

8. CEC-funded studies have also identified port infrastructure as a market barrier to deploy FOSW projects in California. Which research projects do you identify as critical to advance port readiness to support FOSW?

Most studies have referenced the supply chains of the mature European sector to inform requirements for US ports. It could also be useful to categorize ports based on its characteristics for servicing various elements of the supply chain as an inventory. This would reveal development constraints and areas for investment or for further studies to find alternate methods to circumvent deficiencies.