

AN OVERVIEW OF VISUAL IMPACT ANALYSIS FOR OFFSHORE WIND ENERGY

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Abstract.—This paper presents a brief overview of the Bureau of Ocean Energy Management’s regulatory framework for offshore renewable energy and summarizes the status of offshore wind energy projects in U.S. waters. The paper also discusses how visual impact analysis (VIA) will be integrated into the environmental analysis of proposed wind energy projects, the unique characteristics of VIA for offshore wind energy development, and the challenges encountered thus far. The conclusion describes lessons learned and summarizes the future of VIA at BOEM.

INTRODUCTION

The Bureau of Ocean Energy Management (BOEM) within the U.S. Department of the Interior is responsible for managing offshore energy resources on the U.S. Outer Continental Shelf (OCS). The Bureau coordinates energy development, environmental protection, and economic development through the responsible management of offshore resources based on the best available science. BOEM achieves these goals by balancing the needs of multiple interests for the OCS with the development of offshore wind energy facilities.

Regulatory Framework for Offshore Renewable Energy

The Submerged Lands Act (43 USC 1301-1315) and the Outer Continental Shelf Lands Act (43 USC 1331) define BOEM’s responsibility to include lands of the OCS. In a March 1983 Presidential Proclamation, the United States claimed an Exclusive Economic Zone up to 200 nautical miles from the coastline. BOEM’s regulatory authority currently includes submerged lands, subsoil, and seabed extending from 3 to 200 nautical miles off the coastline of the United States, a total of 1.7 billion acres.

Since the Energy Policy Act of 2005 (EPA) (42 USC 15801), BOEM has been responsible for issuing leases, easements, and rights-of-way for activities that support production and transmission of renewable energy on the OCS, including offshore wind, ocean wave energy, and ocean current energy. The regulations and statutes

governing BOEM’s OCS Renewable Energy Program (30 CFR 585) describe authority and responsibilities within four distinct phases of renewable energy development: planning, leasing, site assessment, and construction and operations (Bureau of Ocean Energy Management 2014).

This paper does not describe the entire offshore wind project authorization process, but a summary of the goals of the process may be useful. The planning and analysis stage seeks to identify appropriate wind energy areas through intergovernmental task force coordination, public notices, and public comment. Following environmental analysis and consultations, BOEM may issue a lease on a competitive basis (e.g., lease sale) or, if it is determined that there is no competitive interest, issue a lease noncompetitively (Bureau of Ocean Energy Management 2016a).

There are three types of leases that authorize the use of the OCS for renewable energy projects: limited leases, research leases, and commercial leases. Limited leases are for activities that do not produce electricity for sale, beyond a very limited threshold. Research leases are for State or Federal agencies conducting renewable energy research on the OCS. Commercial leases do not grant construction rights but rather allow a lessee to use an area to develop two required plans. A Site Assessment Plan describes how an applicant plans to collect resource data, typically through the construction of a meteorological tower and/or installation of meteorological buoys on the leasehold. A Construction and Operations Plan describes how an applicant proposes to carry out the construction, operations, and conceptual decommissioning of a renewable energy facility.

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Although BOEM's regulations apply to all forms of renewable energy, the rest of this paper will address offshore wind energy, which is the main type currently under development in the United States. Ocean wave energy is a potentially important future source of energy and demonstration trials are underway on the Northwestern coast of the United States. The technology that harnesses energy from submerged water turbines is also being explored. There are no active leases in Federal waters focusing on hydrokinetic energy technologies at this time but the potential does exist for future development. For a comprehensive view of on- and offshore renewable energy development in the United States, Canada, and Australia, see Smardon et al. (2017).

AN OVERVIEW OF OFFSHORE WIND ENERGY IN EUROPE AND THE UNITED STATES

The offshore wind energy industry is most mature in Europe. At the end of 2016, there were 3,589 turbines in 10 countries with the potential to produce 12,631 megawatts (MW) of electricity annually (Wind Europe 2017). A total of 338 new offshore wind turbines from six wind farms was added to the European grid in 2016 (Wind Europe 2017). It is likely that wind development will continue to play a leading role in electricity production in Europe. Technological innovations include floating turbines, and even artificial islands, are being considered as wind turbine platforms (Moccia et al. 2014).

In contrast, the only offshore wind facility currently in the United States is the Block Island Wind Farm that began operations on December 12, 2016. The project consists of five 6 MW turbines located 3 miles offshore from Block Island, Rhode Island. The structures are 180 m high with a hub height of 100 m and a rotor diameter of 150 m. The electricity from these turbines replaces about 1 million gallons of diesel fuel oil per year, which was once needed to run electric generators on Block Island (<http://dwwind.com/project/block-island-wind-farm/>).

BOEM is following public reactions to this important first project. Several studies are underway to evaluate the economic and social outcomes of the Block Island Wind Farm, including a study on the economic effects on tourism to the island. The study will be completed in the autumn of 2018.

The Block Island Wind Farm itself was not permitted by BOEM. It lies entirely in the State waters of Rhode Island and was subject to regulation by that State and the U.S. Army Corps of Engineers. A part of the transmission cable to the mainland did cross Federal waters, for 9 miles, for which a right-of-way was granted by BOEM.

Current Status of BOEM's Lease Areas in the United States

Numerous large-scale projects, on a scale comparable with European counterparts, are in the planning stage in the United States and BOEM anticipates receiving multiple Construction and Operations Plans over the next year. BOEM has issued 13 commercial wind energy leases off the coasts of Delaware, Maryland, Massachusetts, New Jersey, New York, North Carolina, Rhode Island, and Virginia, totaling over 1.3 million acres as of June 2018.

INCORPORATING VIA INTO THE BOEM PLANNING PROCESS

BOEM provides guidance to lessees about what information the Bureau needs to assess potential project effects under the National Environmental Policy Act (NEPA) (42 USC 4321) and the National Historic Preservation Act (NHPA) (16 USC 470). This guidance recommends completing a visual impact analysis (VIA) to identify and assess effects for both Site Assessment Plan and Construction and Operations Plan applications.

A Site Assessment Plan (SAP) contains the lessee's detailed proposal for the construction of a meteorological tower and/or the installation of meteorological buoys on a lease area. This includes critical information on wave heights, wind speeds, and currents. As of June 2018, six SAPs have been approved for implementation.

To date, the review of SAP applications has found that meteorological buoys have little to no likelihood of having visual impacts. They are rarely visible from shore due to the type of structures and distance from shore. A common type of meteorological buoy proposed by lessees has a mast height of about 13 feet, while others float even lower in the water; studies indicate that these are indistinguishable from vessel traffic. Meteorological towers are larger than buoys,

are fixed to the seabed, and may be visible from shore. A meteorological tower proposed for a wind energy lease area off the coast of Maryland has a planned tower height of 328 feet. BOEM's NHPA review for this facility, which included a VIA, resulted in a finding of no historic properties affected. The Maryland and Delaware State Historic Preservation Offices (SHPO) agreed with the finding. BOEM does not anticipate that many lessees will propose meteorological towers as the trend is for the installation of meteorological buoys for site assessment data collection.

The final stage of the process for applying to construct and operate a wind energy project is submitting a detailed Construction and Operations Plan (COP). At this time, COP guidelines for VIA are very basic and do not provide specific instructions on how to conduct a VIA. Instead, BOEM and potential lessees hold collaborative consultation meetings to outline approaches for environmental and technical topics, including a VIA. The Bureau provides guidance on VIAs to lessees if requested, with the goal of integrating VIAs into the COP process. In practice, both BOEM and the lessees are learning from each other's experiences as COPs are being developed. That experience is being used to develop plans that will meet BOEM's regulatory needs and the needs of the lessee for developing offshore wind energy projects.

BOEM staff review COPs as they are submitted and use the information from the COP in a NEPA analysis, likely an environmental impact statement (EIS), which will include multiple opportunities for public involvement. Visual analysis is part of the NEPA and 106 analyses and includes a broad look at the potential impacts to recreation, economics, historic resources, and other resources. Following completion of a NEPA analysis and consultations, BOEM has the authority to approve, approve with modifications, or disapprove a COP in its entirety.

UNIQUE CHARACTERISTICS OF VISUAL IMPACT ANALYSIS FOR U.S. OFFSHORE WIND

Insights From Europe: Design Envelopes and the Danish Experience

European countries have extensive experience in constructing and operating offshore wind energy projects. The United Kingdom has developed an

approach to project implementation called a Project Design Envelope (PDE). The PDE approach allows a project proponent to submit a reasonable range of design parameters within its permit application. The permitting agency then analyzes the maximum impacts that could occur within the range of design parameters. If approval is granted, the project proponent can move forward with a final design that is within the approved ranges for all parameters.

BOEM supports the voluntary use of the PDE approach and has developed draft guidance for its use in COPs. Comments on this draft guidance are now being assessed with plans to finalize the guidance by the end of 2018. Under these guidelines, VIAs for proposed projects could require analyzing a range of scenarios as discussed in the Challenges section below.

BOEM is also party to a Memorandum of Understanding (MOU) with the Danish government to strengthen cooperation on offshore wind energy projects. This MOU promotes the sharing of information, best practices, and policy initiatives to support development and regulation of offshore wind energy, including the possible effects of these projects on marine mammals, migratory birds, and cultural resources. There is also ongoing information sharing on supply chain grid integration and strategies for achieving cost reductions (Bureau of Ocean Energy Management 2016b).

The insights gained from this relationship are helping BOEM understand the technological development trends for offshore wind. This includes critical factors for VIA such as turbine design and size and the development of floating offshore wind energy generation projects.

CHALLENGES

Public meetings, SAP review and consultation meetings with lessees have highlighted several challenges related to VIAs for potential offshore wind energy projects.

National Environmental Policy Act (NEPA) and the National Historic Preservation Act (NHPA)

The PDE concept, while successful in the United Kingdom, does present several procedural challenges for NEPA and NHPA compliance.

The goal of the design envelope approach is to allow flexibility in the scheduling and design of an offshore wind energy project. Developing a final project design is complicated for a long-term, complex undertaking such as an offshore wind energy project, yet the goal of an EIS under NEPA is a detailed disclosure and analysis of environmental impacts. This includes technical details such as the size, location, and type of turbine foundations, construction noise, and the exact number of turbines among many other factors.

Changes in the location, type, or number of turbines, for example, may require additional analysis of environmental impacts, if outside the scope of the previous NEPA analysis. Additional consultation with Federal agencies as well as consulting parties relating to Section 106 of the NHPA may be necessary.

Compliance with the NHPA also requires careful planning. A change in the number, location, size and/or pattern of turbines could require determining a new area of potential effects (APE), which may in turn require additional analysis of effects to historic buildings, districts, and landscapes. Consultations with SHPOs, Tribal Historic Preservation Offices (THPO), and other affected parties would have to be re-opened to allow for comments on effects to historic resources and eligibility for the National Register of Historic Places.

Traditional Cultural Properties

The National Park Service defines a traditional cultural property (TCP) as “one that is eligible for inclusion in the National Register because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community’s history, and (b) are important in maintaining the continuing cultural identity of the community” (National Park Service undated).

On April 2, 2010, the Advisory Council on Historic Preservation (ACHP) commented on a proposed TCP for Nantucket Sound as part of the Section 106 compliance for a proposed Cape Wind offshore wind project (National Park Service 2012). The ACHP agreed that Nantucket Sound is eligible for inclusion in the National Register as a TCP as both a historical and archaeological property due to the presence of significant archaeological sites. In addition, Nantucket Sound is an integral feature of Mashpee and Aquinnah Wampanoag Tribal culture and history.

In that case, the Secretary of the Interior terminated Section 106 consultations once it became apparent that the consulting parties could not reach an agreement but it is possible that other offshore wind energy projects may affect other TCPs in the future. The criteria for TCPs are meant to be broad and could include other Native American and non-Native American groups on the coasts of the United States.

Information about effects for any TCP will become part of the overall compliance process for the NHPA and NEPA (see Sullivan et al., this proceedings). Mitigation for any TCP could include the types of strategies discussed below with input from the affected public, SHPOs, THPOs, and lessees.

Mitigation Strategies

Both NEPA and Section 106 of the NHPA require mitigation strategies to reduce or remove adverse effects from proposed actions. Any mitigation strategy must weigh a variety of factors including cost, practicality, and support from the affected public and lessees. One example of mitigation under NEPA is incorporating aircraft detection lighting systems (ADLS) to reduce visual impacts. These are sensor-based systems that detect aircraft as they approach an obstruction and automatically activate lights until the aircraft passes. This reduces the visual impact of nighttime lighting for people and reduces the potential impacts for migratory birds.

Mitigation to reduce or remove adverse effects to historic properties is also part of the Section 106 process but devising a way to effectively reduce visual effects to large-scale areas is challenging. One possible strategy is to create historical interpretation materials for an area that would not otherwise have them. This approach is consistent with the definition of “mitigation” as used in the Council on Environmental Quality’s NEPA-implementing regulations and with Section 106 of the NHPA. For example, in one case where an early 20th century mill dam was being removed in South Carolina, several Federal agencies helped develop a mitigation strategy that included preserving detailed engineering drawings and photographs of the dam. The strategy also included creating five roadside interpretive plaques that document the history of the mill and the adjacent village.

THE ROLE OF SIMULATIONS

Visual simulations have proven to be the most significant component of VIA analysis for offshore wind energy projects since they give viewers a way to directly experience the visual effects of a proposed project. Simulations are part of the NEPA scoping and analysis process and are used for determining the APE under the NHPA.

Past experience suggests that simulations for offshore wind should be as realistic as possible. Modeling should include good key observation points and account for the effects of changing sunlight and weather conditions. BOEM's simulation of a hypothetical wind project near New York, for example, shows that visibility from shore depends as much on sun position, fog, humidity, and general atmospheric conditions as distance from shore. Seasonal variation is also an especially important factor on the East Coast of the United States where the weather and visibility patterns of the four seasons are distinct. Simulations that incorporate these factors can be found on the BOEM Website (Bureau of Ocean Energy Management undated).

The developmental pace of each wind lease area will vary. Some will be developed in one phase while others will be developed over a longer period of time, depending on a variety of factors. This means that it may be both practical and effective to do multiple simulations, each with a projected level of development over time. While adding to the cost of a project, accurate simulations of effects over time could be an effective approach to accurately informing the public about potential visual impacts.

THE FUTURE OF VISUAL RESOURCE STEWARDSHIP AT BOEM

Visual resource stewardship is playing a vital role in achieving BOEM's mission for balancing the diverse factors related to offshore wind energy projects. One important step has been creating a cultural resource staff position to work primarily on VIA issues. BOEM's goal is not only to assure compliance for individual projects, but also to develop an approach to visual stewardship that is adaptive and improves over time. This means maintaining close, involved contact

with lessees and learning from experience. Offshore wind power is a dynamic, evolving industry and the technology and tools of VIA are also constantly changing.

Another key step is funding an interagency agreement with Argonne National Laboratory to develop draft guidelines and methodologies for VIAs of proposed OCS wind projects by late summer of 2018. The contract with Argonne specifies that SHPOs, THPOs, wind industry representatives, interested members of the public, and BOEM staff will all have the opportunity to review the proposed guidelines. The contract has a 5-year full performance clause and a third of the budget is reserved for making revisions to the guidelines as projects are actually developed.

The end result will be a set of guidelines and methodologies that promote overall visual stewardship. In practice, each VIA will be completed through a contract between a lessee and a consultant, following the guidelines and methods provided by BOEM.

BOEM is also committed to enhancing coordination and stakeholder engagement. The Bureau is evaluating the structure of relevant intergovernmental task forces with the goal of improving their effectiveness at the State and regional levels. Effective stakeholder engagement allows the public to identify important issues in their communities including the potential visual impacts to tourism and historic properties.

CONCLUSIONS

The goal of VIA at BOEM is to integrate the consideration of visual impacts into orderly, safe, and environmentally responsible renewable energy development activities on the OCS. Achieving this goal will take some time and will depend on the Bureau learning and adapting as offshore wind energy takes its place as an important new source of energy in the United States.

LITERATURE CITED

Bureau of Ocean Energy Management. Undated. **Renewable energy viewshed analysis and visualization simulation for the New York Call Area.** <https://www.boem.gov/New-York-Visual-Simulations/>.

- Bureau of Ocean Energy Management. 2014. **OCS renewable energy program regulations. 30 CFR 585.** <https://www.boem.gov/Regulatory-Framework/>.
- Bureau of Ocean Energy Management. 2016a. **Citizens guide to the Bureau of Ocean Energy management's renewable energy authorization process.** Washington, DC: Bureau of Ocean Energy Management. 19 p. <https://www.boem.gov/note12162016/>.
- Bureau of Ocean Energy Management. 2016b. **Memorandum of understanding between the government of the Kingdom of Denmark and the government of the United States of America to strengthen cooperation on offshore wind energy.** 3 p. <https://www.boem.gov/BOEM-Denmark-MOU/>.
- Energy Policy Act of 2005; **Public Law 109-58, 42 USC 15801.** <https://www.gpo.gov/fdsys/pkg/PLAW-109publ58/pdf/PLAW-109publ58.pdf>.
- Moccia, J.; Wilkes, J.; Pineda, I.; Corbetta, G. 2014. **Wind energy scenarios for 2020.** A report by the European Wind Energy Association – July 2014. 7 p. <https://windeurope.org/fileadmin/files/library/publications/reports/EWEA-Wind-energy-scenarios-2020.pdf>.
- National Environmental Policy Act of 1969; **Public Law 91-190, 42 USC 4321-4347.** https://www.energy.gov/sites/prod/files/nepapub/nepa_documents/RedDont/Req-NEPA.pdf.
- National Historic Preservation Act of 1966; **Public Law 102-575, 16 USC 470 et seq.** <https://www.nps.gov/history/local-law/nhpa1966.htm>.
- National Park Service. 2012. **National Historic Preservation Act, Section 106: A quick guide for preserving Native American cultural resources.** <https://www.nps.gov/history/TRIBES/Documents/106.pdf>.
- National Park Service. Undated. **National Register Bulletin: guidelines for evaluation and documenting traditional cultural properties.** <https://www.nps.gov/nr/publications/bulletins/nrb38/nrb38%20introduction.htm>.
- Outer Continental Shelf Lands Act; **43 USC 1331.** <https://www.boem.gov/Outer-Continental-Shelf-Lands-Act/>.
- Smardon, R.; Bishop, I.; Ribe, R. 2017. **Managing new energy landscapes in the USA, Canada and Australia.** In: Apostol, D.; Palmer, J.; Pasqualetti, M.; Smardon R.; Sullivan, R., eds. The renewable energy landscape: preserving scenic values in our sustainable future. London and New York: Routledge: 41-77. <https://doi.org/10.4324/9781315618463>.
- Submerged Lands Act; **43 USC 1301-1315.** https://www.boem.gov/uploadedFiles/BOEM/Oil_and_Gas_Energy_Program/Leasing/Outer_Continental_Shelf/Lands_Act_History/submerged.pdf.
- Sullivan, R.G.; Meyer, M.E.; O'Rourke, D.J. 2018. **Comparison of visual impact analysis under the National Environmental Policy Act and section 106 of the National Historic Preservation Act.** In: Gobster, P.H.; Smardon, R.C., eds. Visual resource stewardship conference proceedings: landscape and seascape management in a time of change. Gen. Tech. Rep. NRS-P-183. Newtown Square, PA: USDA Forest Service, Northern Research Station: 201-212.
- Wind Europe. 2017. **The European offshore wind industry: key trends and statistics 2016.** Report. 38 p. <https://windeurope.org/about-wind/statistics/offshore/european-offshore-wind-industry-key-trends-and-statistics-2016/>.

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