BOEM Pacific Region: Ongoing Study

Title	Offshore Wind Generation and Load Compatibility Assessment with Emphasis on Electricity Grid Constraints, Mitigation Measures and Associated Costs (PR-19-HSU)
Administered by	Pacific OCS Region
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Conducting Organizations(s)	Humboldt State University, Schatz Energy Research Center
Total BOEM Cost	$537,500
Performance Period	FY 2019–2021
Final Report Due	December 31, 2021
Date Revised	August 26, 2021
PICOC Summary	
Problem	The electrical transmission system in northern California has not been modified in decades. The current electrical grid ('grid') has limited capacity for production and transmission of energy. A deeper understanding of the existing electrical grid and needs of the region is necessary to inform future BOEM decisions for renewable energy development.
Intervention	The purpose of this study is to accurately characterize the grid in northern California and identify constraints, mitigations, modifications and costs to the grid to accommodate future offshore wind energy production and transmission. The study was expanded to analyze optimal wind farm design that could reduce transmission costs for a near-term pathway for offshore wind development on the north coast, and conduct preliminary analysis of the value of large scale offshore wind development off the north coast.
Comparison	Understanding the existing constraints to the grid and the near-term pathways for offshore wind development on the north coast, it will assist in forecasting and predicting future population and load needs for California. This will allow BOEM to have a better understanding of sizing of potential lease areas and future development scenarios.
Outcome	The predicted outcome of this study is an understanding of the existing California grid's capacity to integrate future offshore wind energy from a northern California location. Further outcomes include prediction of future load needs, constraints, mitigations and costs for modifications to the existing grid to accept integration of future offshore wind production. Results also provide value to industry and inform a development pathway for the north coast which could increase lease values.
Context	Northern California

BOEM Information Need(s): This information would be used to better manage OCS resources by informing future leasing decisions for wind energy development. Understanding and characterizing northern California's offshore wind energy resource and associated potential for integration into California's electrical grid will aid BOEM in planning for future leasing decisions, site and impact

characterization, identification of potential locations for future lease sales in the near-term and long-term, and assist in planning stakeholder outreach.

Background: California formally legislated through SB 100 (the Clean Energy and Pollution Reduction Act of 2015) the requirement that 100% of all electricity generated and sold come from renewable energy sources by December 31, 2045. The need for renewable energy sources in California will continue to grow as traditional sources of energy phase out of the power supply equation. This study will provide a foundation for the analysis required to prepare for future offshore wind energy development along the north coast of California through: (1) an understanding of the existing wind energy resources and regional capacity for integration of new sources of power generation through available grid connections; (2) evaluating the economic costs of modifications to existing interconnection and transmission for potential offshore wind projects; (3) identification of potential offshore wind energy interconnection constraints; and (4) evaluation of a conceptual undersea transmission system capable of exporting offshore wind energy produced off northern California and delivered to the San Francisco Bay Area to the south.

Objectives: The overall objective of this study is to assess the feasibility, scale, and transmission options of offshore wind power generation along California's north coast.

Methods: Schatz Energy Research Center (SERC) will build on prior analysis to gather and synthesize the evaluated information into a report concerning the energy resources, estimated load and power output scenarios of potential near-term offshore wind design and operation profiles using options that result in reduced transmission capacity requirements, and study the value proposition of large-scale offshore wind deployment off the north coast of California.

Prior Analysis: In the study to date, HSU identified potential pathways and magnitude of costs for alternative transmission interconnection of multiple offshore wind (OSW) generation scenarios up to the full build-out of the Humboldt Call Area, assuming full deliverability of OSW throughout the whole year, including the worst case (peak) grid conditions resulting in an upper bound estimate for transmission costs. That work was necessary to begin the inquiry, but scope and costs did not allow for sensitivities or optimization of the findings. HSU confirmed that development of OSW resource on the Humboldt Call Area could provide substantial value to the north coast and the state through generation of renewable power. However, electric transmission capacity in the region is a critical limiting factor, and development of transmission lines with capacity to deliver multiple gigawatts of power to the state's main load centers will require substantial investment.

New Tasks: Assessing the value and economic viability of offshore wind development and identifying strategies to enable near-term projects that address constraints associated with the existing transmission infrastructure could provide a development pathway for large-scale deployment of offshore wind off the north coast. The expansion of the cooperative agreement included:

1. Using new simulated data from the National Renewable Energy Laboratory (NREL) released in July 2020, HSU would update the wind generation and grid integration analyses to ensure it is based on the most recent available information.
2. Analysis of wind farm design and operation scenarios using measures such as smart curtailment during periods of transmission congestion, load following, coupling with storage or other measures that could substantially reduce the cost of transmission upgrades.

3. Development of scenarios of wind generation potential beyond what may be developed on the BOEM Humboldt Call Area to inform the value proposition of a large-scale development of offshore wind off the north coast. This analysis will inform the co-optimization for power generation (and therefore inform BOEM leasing strategy) and transmission planning to help in identifying integrated solutions to harness the significant wind resources offshore California.

Specific Research Question(s):

1. What are the potential constraints of the existing electrical transmission grid from offshore wind energy production and transmission?
2. What are the future load needs for California based on the goals of SB 100 and how can BOEM assist California in meeting those goals through offshore wind energy development on the northern California coast?
3. What wind farm development scenarios could provide a pathway for near-term deployment of offshore wind on the north coast to unlock the large-scale potential of the significant offshore wind resources in the region?
4. What is large-scale potential for offshore wind energy development in the north coast area and its value proposition in meeting the goals of SB 100?

Current Status: The cooperative agreement with Humboldt State University, Schatz Energy Research Center was awarded on May 22, 2019. It was modified on October 31, 2019 and further modified on November 20, 2020.

Publications Completed:

Severy M, Younes A, Zoellick J, Jacobson A (compilers). 2020. Northern California Offshore Wind Generation and Load Compatibility Assessment with Emphasis on Electricity Grid Constraints, Mitigation Measures and Associated Costs, Final Synthesis Report. Prepared for Bureau of Ocean Energy Management by Schatz Energy Research Center, Humboldt State University, Arcata (CA). U.S. Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2020-045. 301 p. https://www.boem.gov/BOEM-2020-045

Affiliated WWW Sites: None

References: None