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Offshore Wind on California's North Coast

July 28, 2021

Presented by Arne Jacobson Schatz Energy Research Center





Offshore wind on the California Coast

- California's offshore wind resource has great potential to contribute substantially to the state's climate and clean energy goals
- A National Renewable Energy Laboratory (NREL) study estimated potential for installing wind farms with capacity up to ~21 GW across five areas in federal waters along the north and central coasts of California (Beiter, et al., 2020)



Image source: Wikipedia Commons (https://upload.wikimedia.org/wikipedia/commons/7/76/Agucadoura_WindFloat_Prototype.jpg)

BOEM recently indicated intent to proceed with leasing processes for two areas with combined capacity of up to ~4.6 GW (Humboldt Call Area: 1.6 GW; Morro Bay "399" Call Area: 3 GW)



Schatz Center Offshore Wind Research for CA's North Coast

Project Funders







Governor's Office of **Planning and Research**

Team Members

HUMBOLDT STATE UNIVERSITY

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Major Partners

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MACDONALD

*participated as student researchers





Navy Region Southwest

California North Coast Offshore Wind Study Scenarios



Capacity Factor for Wind Generation in the Humboldt Call Area

Annual Energy Generation



Key Takeaways:

- Offshore wind farms in the Humboldt Call Area could achieve ~52% capacity factor (annual)
- This is favorable compared to typical capacity factors of other renewable generation sources:
 - Land-based wind = 30% 40%
 - Solar PV = 15% 30%

Note: This *net* capacity factor includes losses and down time due to maintenance, weather events, line losses, wake effects, etc.

Offshore Wind's Generation Profile Can Complement Other Renewables

- Offshore wind's time of generation could be a useful compliment to solar and land-based wind.
- Offshore wind has relatively consistent output, on average, throughout the day across all seasons



Time Series Examples of Power Generation

Example Weekly Generation Profiles for 144 MW Offshore Wind Farm in the Humboldt Call Area



Key Takeaways:

- Power generation varies from week to week, even within the same season.
- There are sustained times of maximum generation and low generation.
- Annually, full power operation occurs ~42% of the time; zero power ~16% of the time.

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Transmission Infrastructure is a Constraint for North Coast Offshore Wind Development



Offshore Wind Development and the Humboldt County Electricity System



Key Takeaways:

- Transmission infrastructure is limited. The maximum import/export capacity is ~70-75 MW.
- Projected average regional load for 2030 is 102 MW (Ortega, et al., 2020).

Complementary Technologies Could Support Offshore Wind





- With funding from BOEM, we are conducting a study on transmission and interconnection alternatives for small commercial-scale (50 – 500 MW) offshore wind farms in the Humboldt Call Area. Partners include Quanta Technology and NREL.
- Preliminary results indicate a ~140 170 MW project could be developed without transmission upgrades if interconnection is on an "energy only" basis. Curtailment losses are estimated to occur ~4% to 6% of the time.*
- The project includes preliminary analysis related to the possibility of coupling battery storage or hydrogen generation with a small commercial offshore wind project. Results are expected by the end of the year.

*Results are sensitive to assumptions about the projected regional load and local generation from other sources. The study year was 2030.

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