EVALUATING OFFSHORE WIND ENERGY FEASIBILITY OFF CALIFORNIA'S CENTRAL COAST

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Community Environmental Council

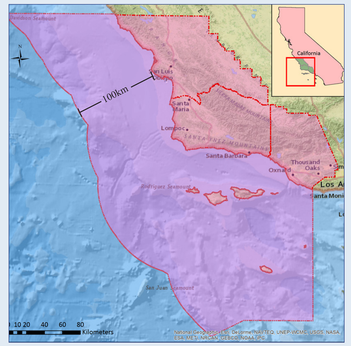
INFINITY WIND POWER

BACKGROUND

Increasing concentrations of anthropogenic greenhouse gases in the earth's atmosphere and associated climate change impacts have catalyzed a global paradigm shift in energy production. Renewable energy offers the potential to meet increasing energy demands with significantly less carbon output than conventional power sources. At the end of 2012, California ranked second among all states (behind only Texas) in installed wind power capacity with 5.549 Gigawatts. However, none of that wind power is being generated offshore.

The effectiveness of offshore wind (OSW) technology has been well demonstrated in Europe. Despite proven onshore technology, offshore wind development's main obstacles in California are deep waters, uncertain environmental impacts created by the technology, conflicting uses of ocean space, and visual impacts.

Our project explores the feasibility of OSW energy generation off the central California coast. The region of interest (ROI) investigated includes Ventura, Santa Barbara, and San Luis Obispo Counties.



Region of interest: the purple shaded area represents the project ROI (mean high tide line to approximately 100 km offshore).

OBJECTIVES & ASSUMPTIONS

Objectives

Determining the overall feasibility of OSW energy development requires detailed analyses of political dynamics, regulatory frameworks, electrical infrastructure, as well as economic, ecological, and social considerations. Our scope of work focused on three facets of OSW development:

1) Stakeholder Analysis
- Identify major stakeholders
- Determine their opinions on OSW development

2) Permitting Analysis
- Identify process for gaining approval
- Identify disproportionate representation of stakeholder groups and protected species

3) Spatial analysis of the marine environment
- Identify and locate major competing uses of ROI
- Identify and describe interactions of major uses

Assumptions

Currently, there are no development proposals for OSW farms in California. Therefore, conducting spatial and permitting analyses required a hypothetical development scenario. The assumptions for that scenario included:

1) Floating turbine platform technology: an OSW farm will occur in waters too deep for conventional turbine platforms to be technologically/economically viable.

2) 33-6 MW wind turbines (198MW rated capacity) in a 10km x 10km spatial array.

Floating wind turbine prototype off the coast of Portugal. (Photo courtesy of Principle Power, Inc.)

CONCLUSIONS

Stakeholder Analysis
- A majority of respondents indicate support and increased willingness to pay for OSW.
- Perceived impacts to seabirds, marine mammals, and views are primary stakeholder concerns.
- Development far from shore is preferred to near-shore development.

Permitting Analysis
- The path to gaining comprehensive permitting approval involves a multitude of steps. A BOEM Task Force is needed.
- Disproportionate representation exists in the regulatory structure.
- Baseline environmental data gaps currently exist that federal government could fill.

Spatial Analysis
- Several areas score high in all four MCDA scenarios.
- Marxan analysis aligns with MCDA results to show lower conflict areas for potential OSW development.
- Validity of results is driven by accuracy of data.

Summary Conclusions

Based on the parameters examined in this project, OSW development is feasible off California's central coast; *however, development barriers exist:*

1. Some stakeholders oppose OSW development. Concerns expressed by stakeholders include impacts to marine life and viewsheds.
2. State and federal permitting paths lack integration and need coordinated effort.
3. Environmental baseline data are incomplete and/or outdated.

Our research indicates that these barriers may be overcome:

1. Survey respondents indicate support and increased willingness to pay for OSW. Environmental and viewshed impacts should be considered in site selection studies.
2. Effective methods of streamlining the regulatory process exist on the East Coast and could be implemented in the ROI.
3. Once better baseline data are gathered, a framework exists for identifying areas of least conflict for OSW.

ANALYSIS

Stakeholder Analysis

Methodology

To gauge broader public attitudes towards OSW, we ran an online survey from September 16, 2013 to November 20, 2013. It was publicized through community listservs, an article in the *Santa Barbara Independent*, and targeted outreach to under-represented stakeholder groups. We collected 475 responses, with 351 respondents residing in the project ROI.

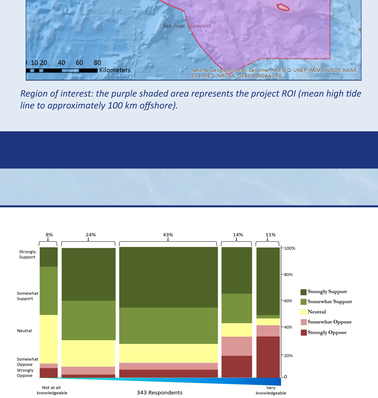
Results

- A majority of respondents (67%) showed a supportive attitude towards OSW, and as individuals' self-professed knowledge increased, their opinions on OSW grew more polarized.
- The top three positive impacts for OSW are "GHG reduction," "fossil fuel reduction," and "supply of renewable energy"; OSW supporters care more about "bird species," while opponents care more about "visual impact" in terms of negative impacts.
- The location preference of respondents for an OSW energy development is consistent with a "Not In My Backyard" (NIMBY) reaction (i.e., respondents preferred sites that were the furthest away and showed the least preference for sites close to shore).
- A binary logistic regression model was used to identify factors influencing respondents' attitudes. Self-professed knowledge, work industry, residence location, and gender of respondents are significant factors at the 5 percent level ($p<0.05$).

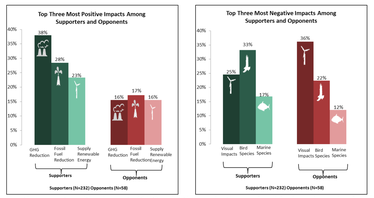
Factors Predicting Support of OSW

Factor Influencing Support	Effect
Location of residence	Santa Barbara County residents more likely to support
Sex of respondent	Females more supportive
Respondent's level of knowledge of OSW	Intermediate level of knowledge of OSW most supportive
Respondent's work industry	Workers in environmental or energy industry most supportive

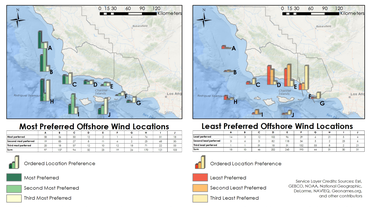
Based on logistic regression of respondents indicating "strong" or "somewhat" support vs. those indicating "strong" or "somewhat" opposition (n=226). All variables were significant with P<0.05.



Mosaic plot indicating that offshore wind attitudes vary with offshore wind knowledge. X-axis width represents the percentage of respondents in different knowledge levels; the width on the y-axis represents the distribution of attitudes within each knowledge level.



Top three most positive impacts (GHG reduction, reduction on fossil fuels and supply of renewable energy) and top three most negative impacts (visual impact, impact on bird and marine species) among offshore wind supporters and opponents.



Offshore wind development location preferences. Most preferred locations (above left) are located away from shore and the Santa Barbara Channel while the least preferred locations (above right) are located nearshore in the Channel.

Permitting Analysis

Methodology

Permitting pathways were identified by systematically reviewing relevant legislation, agencies, and permits associated with OSW development. Although few relevant case studies of OSW development in the United States exist, interviews with agency and industry representatives allowed the team to identify salient points and gain a practitioner's perspective of environmental regulations.

Results

Analysis of the permitting pathway revealed several issues that impact the development of OSW in the ROI:
- Up to 28 separate approvals may be required prior to wind farm construction, including up to three separate NEPA reviews. The exact number of approvals cannot be determined until the approval process has been initiated by a OSW developer.
- Patterns of disproportionate representation emerged; some avian species have as many as four federal statutes and associated permits. By contrast, important stakeholder groups, such as First Nation tribes and commercial fishermen, are largely absent from regulatory requirements.
- The Department of Defence (DoD) Sea Range is a unique area used as a laboratory setting for testing military equipment and is located in the ROI. DoD concerns over the effect of wind turbines on military radar systems may limit a developer's ability to obtain Federal Aviation Administration approval for projects off the central coast.

Regulatory burdens on OSW could be substantially reduced if the State requested the creation of a Bureau of Ocean Energy Management (BOEM) Task Force (as has been done on the East Coast) to coordinate data collection, streamline the permitting process, and coordinate stakeholder communication. This would require investment of state and federal funds.

The infographic is a graphic depiction of the major elements in the permitting process. We developed this infographic to communicate the broad outlines of the permitting process to the general public.

Spatial Analysis

Methodology

We employed a GIS-based multi-criteria decision analysis (MCDA) framework and supplementary Marxan analysis to simulate the siting of wind energy farm(s) in the ROI. To approximate developable areas, we converted the ROI into 100km² "developable" grid cells, and calculated scores for a series of variables within each cell. Cells that intersected or were within shipping lanes and National Marine Sanctuaries were excluded.

For the MCDA analysis, individual variable scores were weighted to calculate an overall cell score. We considered the following variables:

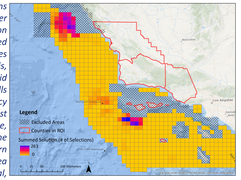
Spatial Analysis Variables	
Benthic substrate	Marine bird biodiversity
Salmon and dragging fishing grounds	Marine mammal presence
Department of Defense Sea Range	Wind speed and distance to onshore interconnection

Results

Two significant patterns emerged:
- The area west of Santa Barbara County consistently received low scores. This is likely because of the region's biological importance as an "upwelling" zone, which supports higher fish, bird, and marine mammal populations.
- Cells in the northwestern portion of the ROI scored high consistently because the area has high wind, is outside of the DoD's Sea Range, has soft substrate, low scores of marine bird biodiversity and mammal presence, and is outside of important dragging and salmon fishery areas.

Each GIS-MCDA scenario represents the prioritization of different stakeholder variables. For example, in the DoD perspective map, we placed a higher penalty on cells within the Sea Range to avoid wind farm placement within areas used for Air Force and Navy exercises. Dark green cells indicate high development potential and red cells indicate areas with low development potential (combination of wind speeds, distance to shore, and degree of spatial conflict). Pink cells were the highest scoring in all four scenarios.

Marxan summed solutions (frequency of cell selection over 1000 runs) with a wind generation target of 200MW and a weighted sum cost inclusive of all variables considered in the MCDA analysis, as well as distance to a grid interconnection point. Here, cells selected with the highest frequency to achieve the target at the lowest cost appear in red, pink, purple, and blue (highest). Similar to the MCDA analysis, the northwestern region again emerged as an area with high development potential, along with the area south of San Miguel and Santa Rosa islands.



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For additional information please visit our website: http://www.calwindproject.com/