Identifying and Addressing Environmental Effects and User Conflicts For Offshore Wind on the West Coast*

Andrea Copping[1]

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Abstract

Offshore wind along the US coastlines is under development as an addition to "all of the above" approach to the national energy portfolio. Offshore wind turbines take advantage of strong and consistent winds, and potentially avoid many of the stakeholder concerns that are faced by the development of land-based wind. Off the west coast of the US, the continental shelf drops rapidly, eliminating the potential for large-scale development of seabed-mounted turbines such as those that are under development in the Atlantic. Floating designs for wind turbines are advancing in the US and abroad, and appear well suited for this coastline. As these new wind capture technologies progress, the ability to test and deploy offshore wind farms must develop assessments of potential environmental effects and stakeholder conflicts that may arise. Following deployment, robust monitoring programs will be needed to determine whether deleterious effects are noted, and to provide guidance for future development.

The objectives of this article are: (1) To examine the key environmental and user challenges facing offshore wind development along the west coast, (2) to set priorities among all potential interactions between offshore wind development and the environment, and (3) to propose methodologies for accelerating the development of offshore wind farms. Determining key environmental concerns of offshore wind requires knowledge of the biology and ecosystem interactions between living resources such as seabirds, marine animals, fish, and the habitats that support them, with specific aspects of wind towers and turbines, power cables, mooring lines and other portions of a wind system. These interactions must be examined throughout all phases of a wind project: construction/installation, operation, maintenance and decommissioning. Regulatory requirements and local ordinances play a key role in determining what data must be collected prior to installation, as well as monitoring needs throughout the life of the project. The presentation will include brief descriptions of two research projects: a site suitability analysis for offshore wind in California, and the initial steps in developing the west coast's first offshore wind farm.

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Identifying and Addressing Environmental Effects and User Conflicts for Offshore Wind on the West Coast

Dr. Andrea Copping
Pacific Northwest National Laboratory

Oxnard CA, May 5th 2015

Today….

- Offshore wind resources in the US and in California
- Importance of environmental effects for accelerating offshore wind development
- Setting priorities for environmental effects of OSW
  - Choosing the interactions that matter
  - Regulatory drivers
  - Interactions with stakeholders
- Suitability analysis for OSW
- WREN international initiative
- Information on OSW available on *Tethys*

Offshore Wind Resources in California

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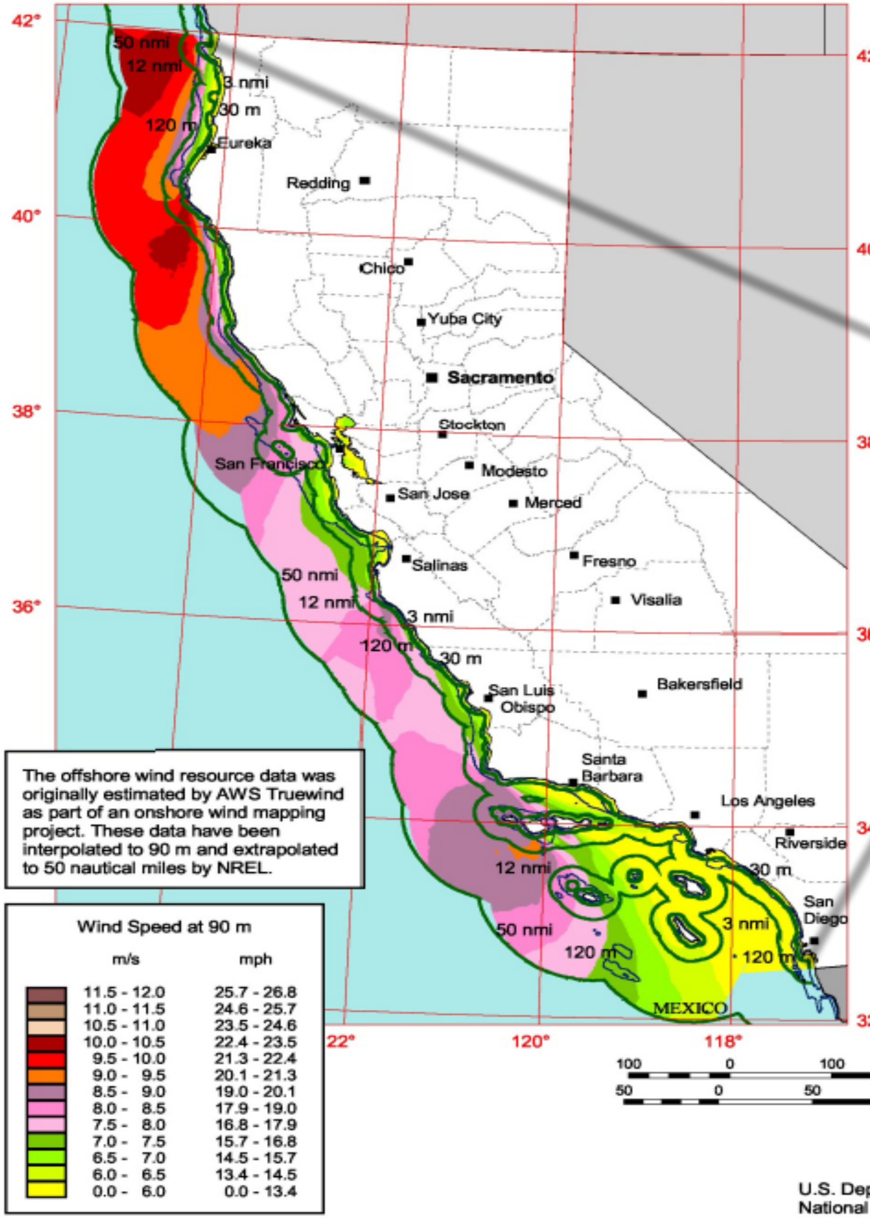

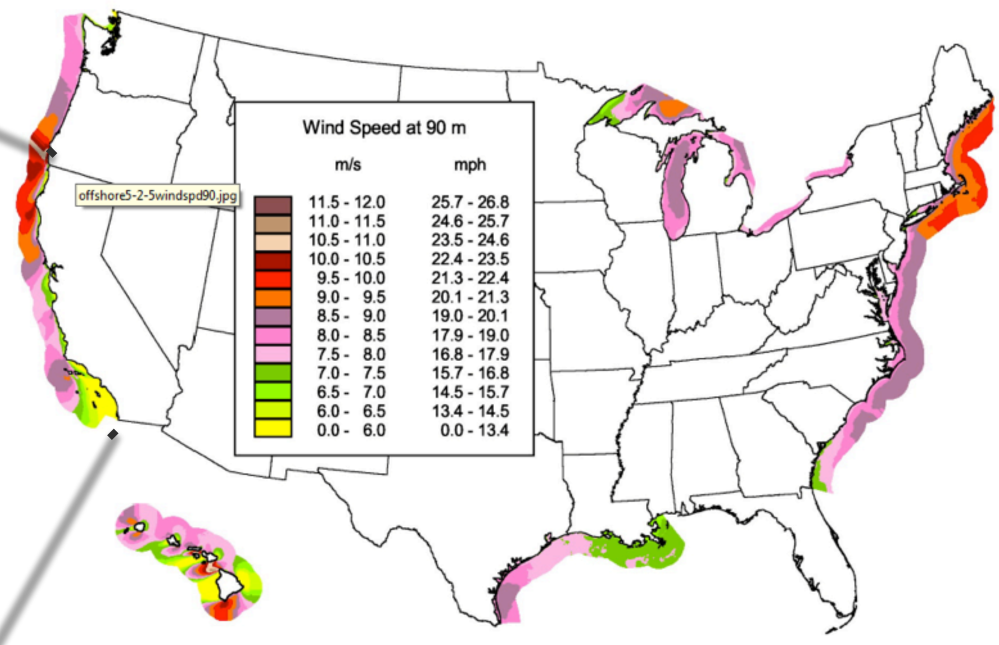

100 0 100 200 300 Kilometers
50 0 50 100 150 Nautical Miles

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Bottom-Mounted versus Floating OSW Turbines

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Overall Strategy for Environmental Conditions

1. Determine environmental priorities for interaction b/tw specific OSW technology and marine animals, habitats, ecosystem processes:
   - Scientific literature, databases and studies
   - In consultation with resource agencies and stakeholders
2. Determine gaps in baseline data, plan studies to fill gaps.
3. Work with regulatory and resource agencies to help inform siting and permitting processes.
4. Determine post-installation monitoring needs, design monitoring studies, progressing towards mitigation, if needed.

Identifying Environmental Priorities

Understand project to determine key stressors as trigger points

- Location
- Depth
- Physical characteristics of platform, turbine, tower, power cables
- Substrate/anchoring mechanism

<u>Field Studies:</u>

California -
State of CA, UC and CSU systems

Oregon –
OSU NNMREC studies for test site
Seabird studies (OSU, USFWS)

Identify specific populations, habitats at potential risk, taking into account regulatory status

<u>Theoretical Studies:</u>
Case study for offshore wind in West Coast
Environmental Protocols off west coast (as hypothetical) = WindFloat

ERES screening analysis of fixed bottom and floating OSW (PNNL)

<u>Priority Environmental Interactions</u>

Engage with agencies and stakeholders to understand appropriate baseline assessment and post-installation monitoring needs

Examining Environmental Interactions

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Receptor Group	Species	Information	Outcome (Based on potential for temporal and spatial interaction)
Birds	Short-tailed Albatross	Distributed along continental shelf and in coastal upwelling spots; OR is southern portion of range. Follows fishing vessels. ESA: Fed. and State End.	**Important interaction:** for all phases of project; especially operation. Consult USFWS.
	Marbled Murrelet	Forage mostly nearshore (1-5 miles) on schooling fish; seen up to 45 miles offshore. ESA: Fed. and State Th.	**Potentially important interaction:** Interaction possible for monopoles, unlikely for floating. Consult USFWS.
	Xantus's Murrelet	Mostly found in S. California, can migrate North into British Columbia. Nest within Channel Islands. After breeding, some move far out to sea. ESA: State Th.	**Potentially important interaction:** Interactions possible for monopoles, unlikely for floating; Consult USFWS.
	California Least Tern	Nest in San Francisco Bay, Sacramento River delta, and Southern CA. Feed in nearshore; migrate south during the winter. ESA: State and Fed. End.	**Potentially important interaction:** Interaction unlikely. Consult USFWS.
	Common Murre	Dive up to 180 meters; found in open ocean. MBTA.	**Potentially important interaction:** Interaction possible for monopoles, unlikely for floating. Consult USFWS.
	Leach's Storm Petrel	Pelagic breeders; may fly 100 miles offshore. Flies low over water and have been known to follow ships. MBTA.	**Potentially important interaction**; interaction may be unlikely. Consult USFWS.
	Brown Pelican	Feed on schooling fish; typically found in coastal areas. ESA: State End; MBTA	Probably not found at sites; Consult USFWS.

Interactions that Matter

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→ Location Matters

→ Technology-specifics matter

- Stressor – any part of an offshore wind installation that may cause stress to the marine environment:
  - Construction noise (pile driving)
  - Turbine and tower
  - Platform (floating)
  - Anchor lines (floating)
  - Power cable

- Receptor – that portion of the marine environment that might be harmed by the offshore wind installation
  - Marine animals (birds, marine mammals, fish, turtles, invertebrates)
  - Habitats (bottom habitats, water column, intertidal)
  - Ecosystem Processes (changes in sediment transport, water quality, etc.)

Refining the List of Environmental Priorities

- Examine occurrence/abundance of animals and habitats at project site offshore
- If animals are present, will they be affected by floating OSW:
  - Rotor swept area and height over sea surface
  - Cetacean interaction with mooring lines & cables
  - Pinniped haul outs
  - Popular fishing areas
  - Acoustic output and vibrations from turbines affecting marine mammals
- Fixed bottom turbines also need to consider:
  - Pile driving noise
  - May affect habitats due to scour of soft-bottom sediments

Priority Environmental Interactions – assuming offshore floating turbines

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1. Birds: Short-tailed Albatross, shearwaters, petrels, maybe murrelets, terns.
2. Hoary bats
3. Marine Mammals
   1. Cetaceans: Humpback and other great whales (Blue, Sei, North Pacific Right, and Fin whales)
   2. Pinnipeds: Steller sea lions and northern elephant seals
4. Fish
   1. Coho salmon and green sturgeon
   2. Albacore and other commercially important fish species
5. Deep sea corals and rocky reefs
6. Sea turtles

Identifying Priorities – Other Considerations

→ Regulations

→ Current Ocean Uses

- Regulatory status:
  - Endangered Species Act (ESA)
  - Marine Mammal Protection Act (MMPA)
  - Migratory Birds Treaty Act (MBTA)
  - Magnuson-Stevens Fisheries Conservation and Management Act (MSFCMA)
  - State statutes and regulations, local, tribal considerations

Federal and State Interactions

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Federal Agencies	Jurisdiction	California Agencies	Jurisdiction
Bureau of Ocean Energy Management	Leasing, lead agency for NEPA **outside state waters**	CA Department of Fish and Game	California Endangered Species Act (CESA), Listed species
U.S. Army Corp of Engineers	CWA 404; Rivers and Harbors Act, Lead agency for NEPA **within state waters**	California Coastal Commission	CZMA, Coastal Development Permit
U.S. Fish and Wildlife Service	ESA, MBTA	California State Lands Commission	California Environmental Quality Act (CEQA); seabed leasing
NOAA Fisheries	ESA, MMPA, MSFCA, CZMA	State and Regional Water Quality Control Boards	State Water Quality Certifications; Wetlands and riparian areas;
Federal Energy Regulatory Commission	Interconnect	California Natural Resources Agency	California Environmental Quality Act (CEQA)
U.S. Coast Guard	Navigation	California Ocean Protection Council	California Environmental Quality Act (CEQA)
Federal Aviation Administration	Aviation, Flight paths		
DOD - Navy	Military shipping, operations		

Ocean Uses

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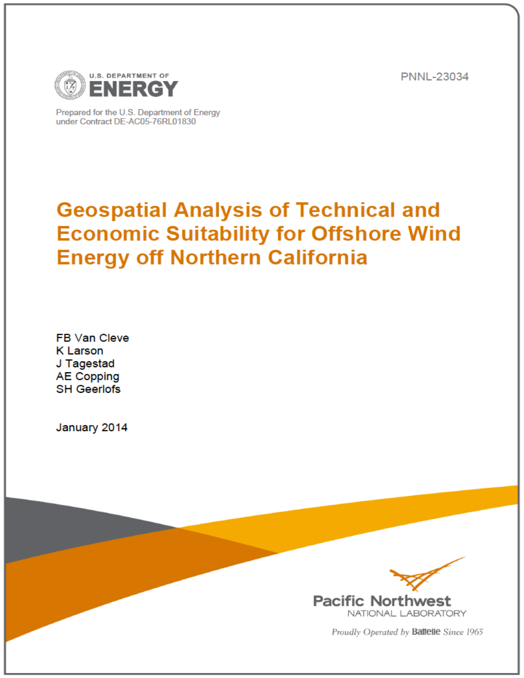
- Current ocean uses:
  - Commercial fishing
    - Nearshore (crabbing, salmon)
    - Offshore (albacore, whiting)
  - Recreational fishing
  - Boating, surfing
  - Conservation
- Important to engage with each group, esp. fishing and environmental
- Fishing is tough - our experience with WindFloat Pacific in Oregon
- Key solution: need CMSP, Wind Energy Areas…??

Renewable Ocean Energy Suitability Mapping

- Developed to inform WA CMSP process
- To identify most “desirable” locations for potential energy development, in next 5-7 years
- Methods = expert interviews + geospatial analysis; adapted/expanded from suitability analysis by Parametrix and OWET in Oregon
- OSW suitability completed off northern California, just finishing up off Oregon
  - Includes OSW fixed foundation and floating platform
  - Analysis of suitability via 8 attributes of site quality, grid connection, and shore-side support
  - Scope is limited to technical and basic economic feasibility


U.S. DEPARTMENT OF ENERGY

PNNL-23034

Prepared for the U.S. Department of Energy
under Contract DE-AC05-76RL01830

Geospatial Analysis of Technical and Economic Suitability for Offshore Wind Energy off Northern California

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AE Copping
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January 2014

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Model Development

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Parametrix

Example = scored attribute tables for offshore wind floating platform

Site Quality Sub-Model

Attribute: Mean Annual Wind Speed*

Ref.	Classification	Score
1	0-6.0 m/s	0
2	6.0-6.5 m/s	2
3	6.5-7.0 m/s	5
4	7.0-7.5 m/s	9
5	> 7.5 m/s	10

*Measured at 90 meters above the surface

Attribute: Depth

Ref.	Classification	Score
1	0m < 10m	0
2	10m < 20m	0
3	20m < 30m	0
4	30m < 40m	0
5	40m < 50m	5
6	50m < 60m	8
7	60m < 200m	10
8	200m < 300m	9
9	300m < 1000m	8
10	>1000m	7

Attribute: Substrate

Ref.	Classification	Score
1	Rock	1
2	Gravel	2
3	Sand	3
4	Cobble	2
5	Mud	3

Grid Connection Sub-Model

Attribute: Distance to Substation

Ref.	Classification	Score
1	<5 NM	10
2	5 NM < 10 NM	9
3	10 NM < 15 NM	7
4	15 NM < 20 NM	4
5	> 20 NM	1

Attribute: Distance to Shore

Ref.	Classification	Score
1	1 NM < 5 NM	10
2	5 NM < 10 NM	8
3	10 NM < 15 NM	6
4	15 NM <20 NM	3
5	> 20 NM	1

Attribute: Distance to KV Line

Ref.	Classification	Score
1	0 <3 NM	10
2	3 NM < 6 NM	9
3	6 NM < 9 NM	8
4	9 NM < 12 NM	4
5	12 NM < 15 NM	2
6	> 15 NM	1

Shore-side Support Sub-Model

Attribute: Distance to Service Port

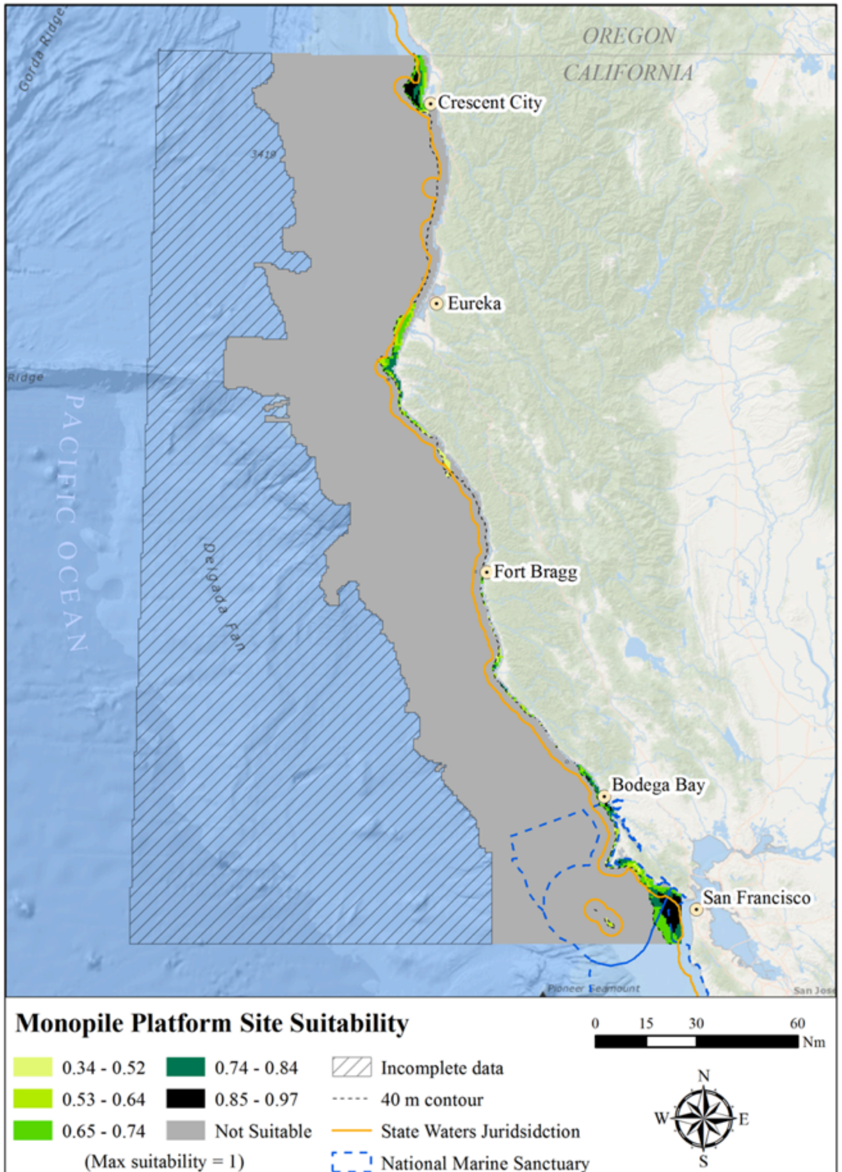
Ref.	Classification	Score
1	<5 NM	10
2	5 NM < 10 NM	9
3	10 NM < 15 NM	8
4	15 NM < 20 NM	7
5	20 NM < 25 NM	6
6	25 NM < 30 NM	5
7	30 NM < 50 NM	3
8	>50 NM	1

Attribute: Distance to Deepwater Port*

Ref.	Classification	Score
1	<5 NM	10
2	5 NM < 10 NM	10
3	10 NM < 20 NM	10
4	20 NM < 30 NM	9
5	30 NM < 40 NM	8
6	40 NM < 50 NM	7
7	50 NM < 100 NM	4
8	100 NM < 150 NM	3
9	150 NM < 200 NM	2
10	>200 NM	1

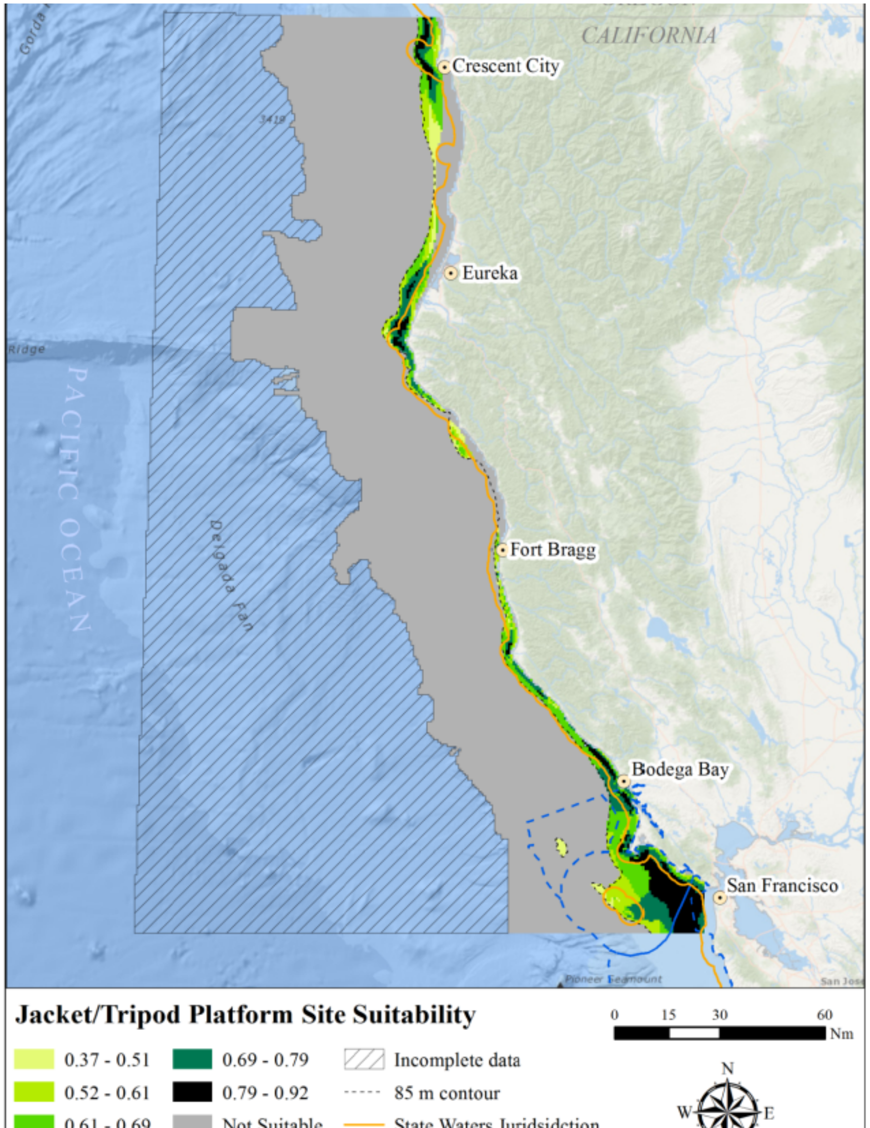
*If ocean access from the port is blocked by an overwater structure > 180m, the port is not considered.

Monopile Site Suitability - California



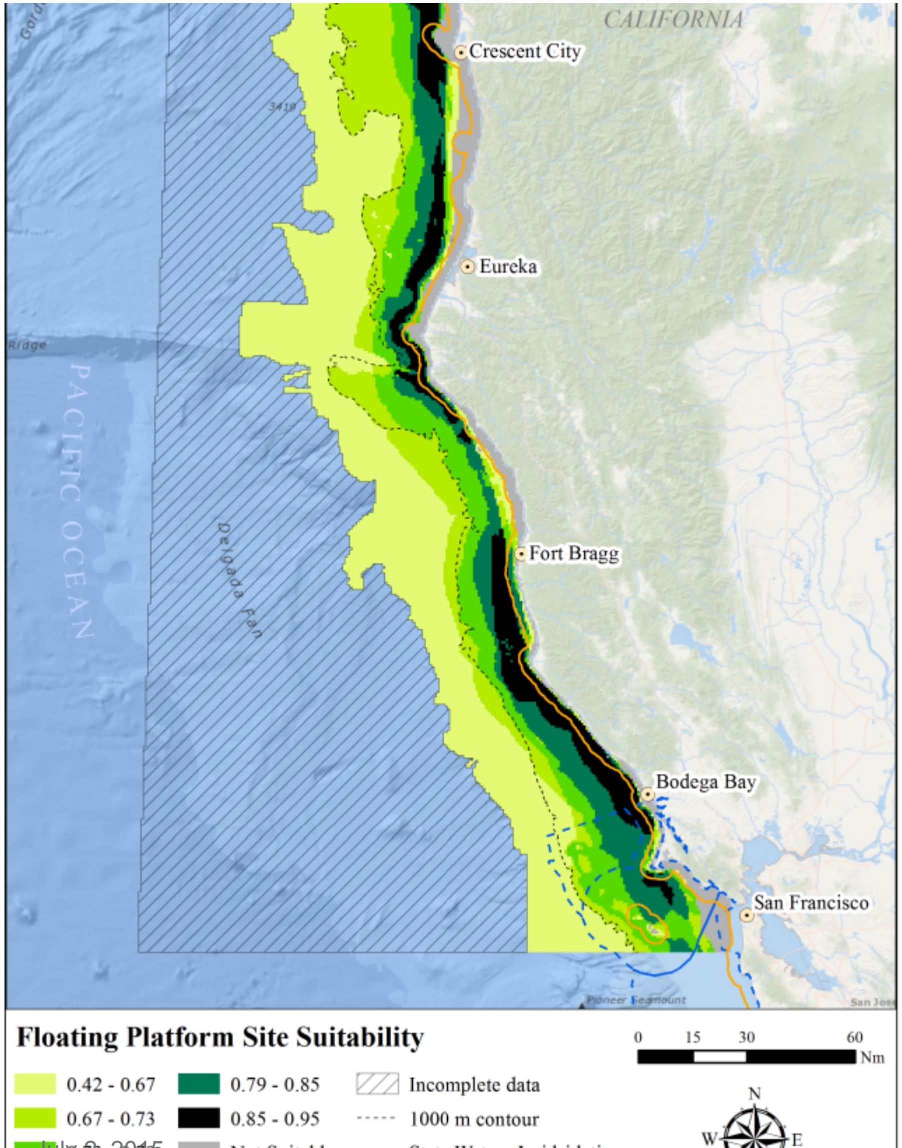
- Water depths ~0-30m
- Very limited potential for monopole wind
- A few sites near Crescent City, San Francisco Bay

Jacketed/Tripod Site Suitability - California



- Water depths ~30-60m
- More area available
- Most suitable sites around Crescent City, Humboldt, SF

Floating Offshore Wind Site Suitability - California



- Water depths >~50m
- Very large potential for floating wind from outer edge of depths for jacketed turbines, across shelf and onto continental slope, even deep sea (??)

Offshore Wind Suitability - Washington State

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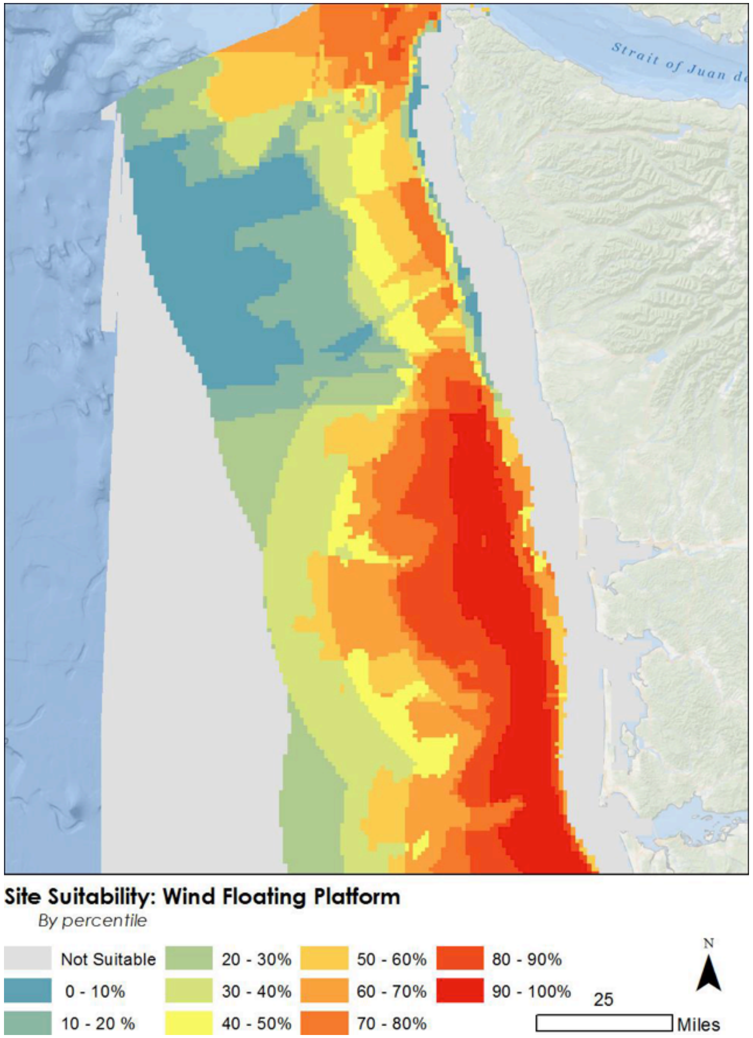
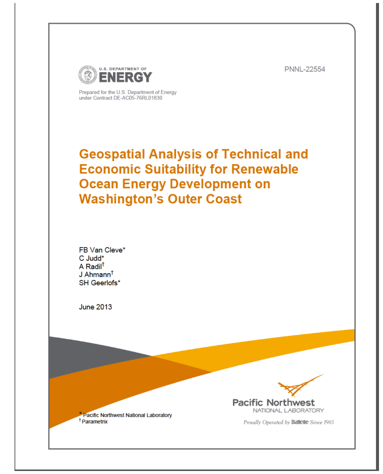


Site Suitability: Wind Floating Platform
By percentile

Parametrix



U.S. DEPARTMENT OF ENERGY

PNNL-22554

Prepared for the U.S. Department of Energy
under Contract DE-AC05-76RL01830

Geospatial Analysis of Technical and Economic Suitability for Renewable Ocean Energy Development on Washington's Outer Coast

FB Van Cleve*
C Judd*
A Radil†
J Ahmann†
SH Geerlofs*

June 2013

* Pacific Northwest National Laboratory
† Parametrix

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- Analysis included suitability of fixed bottom and floating offshore wind, wave, and tidal energy development.
- To address the question: *Assuming a decision to develop off WA in the near-term (5-7 years), what areas would be most economically desirable?*

Summing Up:

- West coast environment
  - Great wind resources: OR, WA, No. California (to Point Conception)
  - Important to determine animals, habitats at risk
- Collect, refine, set priorities for baseline data to inform siting and leasing/permitting processes
- Engage with stakeholders early and often, esp. ocean users; fishing communities for west coast = User conflicts could be decreased with CMSP, creating WEAs
- Once leasing/permitting underway:
  - Identify key interactions for post-installation monitoring
  - Design monitoring studies to examine interactions
  - Develop mitigation strategies if needed

WREN – A New International Collaborative Under International Energy Agency Wind

Karin Sinclair, National Renewable Energy Laboratory
Andrea Copping, Pacific Northwest National Laboratory
Patrick Gilman, U.S. Department of Energy

Credit: Bjørn Iuell, Statkraft. Smøla Wind Facility, Norway

- Facilitate international understanding of environmental effects of offshore and land-based wind energy development
- Eight nations presently, lead by US
- Develop white papers (adaptive management; individual to population effects…)
- WREN Hub (http://tethys.pnnl.gov/about-wren)

Implementing Agreement for Co-operation in the Research, Development, and Deployment of Wind Energy Systems

Tethys.pnnl.gov

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Environmental Effects of Renewable Energy from the Sea

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Get Started Here: Access the Tethys Knowledge Base

Tethys is a knowledge management system that gathers, organizes, and provides access to information on the environmental effects of marine and hydrokinetic (MHK) and offshore wind energy development. This information is made available by

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The European Commission's competitive Horizon 2020 programme has awarded €1.4 million to fund the Risk-based Consenting of Offshore Renewable Energy (RiCORE) project.... **Read More**

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Tethys Map Viewer

Title	Author*	Date**	Type of Content	Technology Type	Stressor	Receptor	Collection
An Economic and Environmental Assessment of Transporting Bulk Energy from a Grazing Ocean Thermal Energy Conversion Facility	Gilmore, E., Blohm, A., Sinsabaugh, S.	November 2014	Journal Article	OTEC	N/A	Farfield Environment	Tethys
Simulating Blade-Strike on Fish Passing Through Marine Hydrokinetic Turbines	Romero-Gomez, P., Richmond, M.	November 2014	Journal Article	In-Stream, Tidal	Dynamic Device	Fish	Tethys
Is EIA Part of the Wind Power Planning Problem?	Smart, D., Stojanovic, T., Warren, C.	November 2014	Journal Article	Offshore Wind	N/A	N/A	Tethys
Wave Farm Impact: The Role of Farm-to-Coast Distance	Iglesias, G., Carballo, R.	September 2014	Journal Article	Wave	Energy Removal	Farfield Environment	Tethys
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- Project Site Annex IV (80)
- Research Study Annex IV (48)

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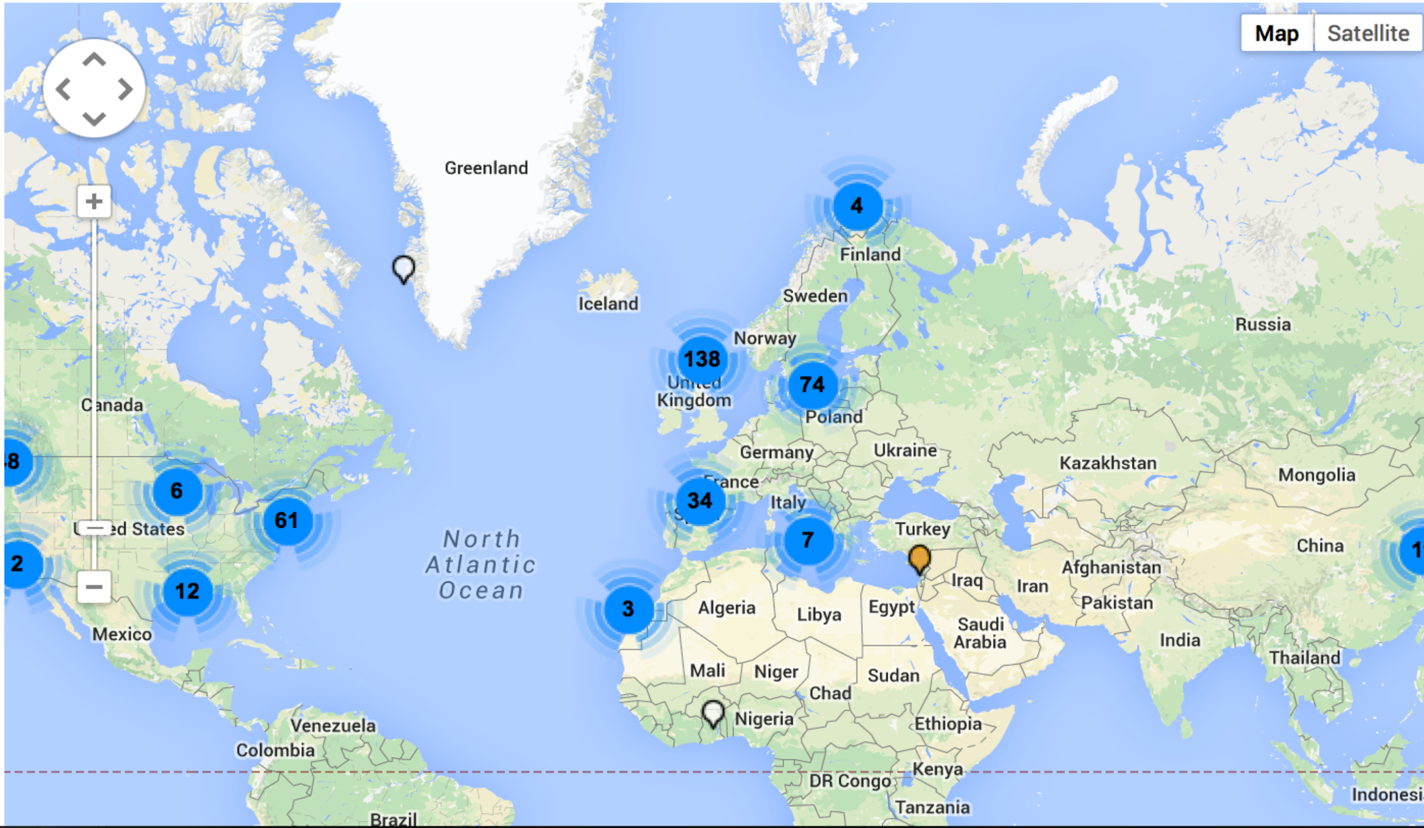
Map Viewer

The Map Viewer compiles documents, U.S. permitting sites, and international Annex IV project sites and research studies that are associated with a geographic location (but not all Tethys content is geotagged). This view allows panning and zooming, while results can be narrowed by keyword searches and by selecting values in the boxes to the right. Learn more about the filtering **here**. Clicking on a bubble will open a dialogue box with more information that links to the document page.

Tethys Knowledge Base



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Legend

- Documents (306)
- Project Site Annex IV (79)
- Research Study Annex IV (28)
- Permitting Site FERC (17)

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Thank you!

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I would like to thank my very talented research team, our many collaborators, DOE's Wind and Water Power Technologies Office, and the many offshore wind developers and researchers around the world.