



# Offshore Wind: Consideration for CMANC Stakeholders

January 10, 2019

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- ✈ Current project
- ✈ Potential future markets
- ✈ Long-term potential prospects

# Typical Offshore Wind Farm Life Cycle

Planning and  
Analysis

Leasing

Site Assessment

Construction

Operations and  
Maintenance

Decommissioning

## 5? Years

- Offshore Wind Master Plans
- Desktop Studies
- Permitting

## 1 Year

- Metocean (resource) observations
- Environmental Assessments
- Protected Species
- Site Assessment Plan

## 2 Years

- Geophysical/geotechnical Investigation
- Archaeologic Clearance
- Foundation Design
- Cable Risk Study
- Construction Operations Plan

## 2 Years

- Importation
- Manufacture
- Transportation
- Cable Installation
- Shoreside infrastructure

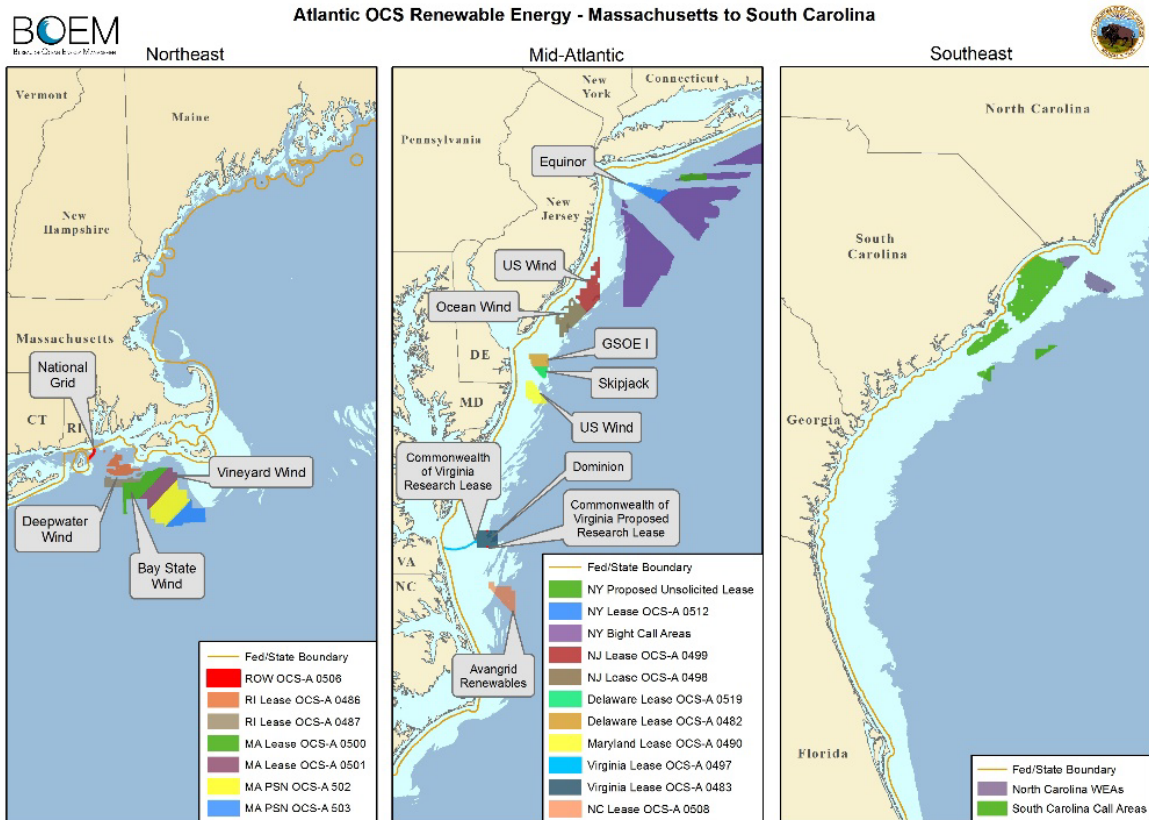
## 25 Years

- Maintenance
- Monitoring
- Environmental Monitoring

# US East Coast OWF Developments

Lease developments underway from Massachusetts to North Carolina:

- MA = >4,800 MW
- NY = 2,400 MW
- NJ = 3,500 MW
- RI = 400 MW
- CT = 200 MW
- MD = 390 MW
- VA = 12 MW
- NC = 1,500 MW



# Projects Moving Forward (East Coast)

Location/State	Project Name	Developer
Maryland	Skipjack	Ørsted
Maryland	Maryland Offshore Wind	US Wind
Massachusetts	Bay State Wind	Ørsted & Eversource
Massachusetts	Block Island	Ørsted
Massachusetts	Vineyard Wind	Vineyard Wind (Copenhagen Infrastructure Partners & Avangrid)
New Jersey	Ocean Wind	Ørsted
New Jersey	Atlantic Shores Offshore Wind	Atlantic Shores Offshore Wind (EDF Renewables & Shell New Energies)
New York	South Fork Wind Farm	Deepwater Wind
New York	Empire Wind	Equinor
Rhode Island & Connecticut	Revolution Wind	Ørsted
Virginia	Coastal Virginia Offshore Wind	Ørsted & Dominion Energy

## Projects Leased but Not Started (East Coast)

Location/State	Project Name	Developer
North Carolina	Kitty Hawk	Copenhagen Infrastructure Partners & Avangrid
Massachusetts	TBD	Equinor
Massachusetts	TBD	Mayflower (Shell)
Massachusetts	TBD	Vineyard Wind

# 2020-2023+ US East Coast (Expected Operational Year)

## 2020

1. Vineyard Wind (MA)

## 2021

2. Ørsted BSW (MA)
3. Ørsted (DWW) SFWF (NY)
4. EDF/US Wind MD (MD)

## 2022

5. Ørsted (DWW) Skipjack (MD)

## 2023

6. Ørsted (DWW) Revolution Wind (RI & CT)
7. Equinor Empire Wind (NY)
8. Ørsted Ocean Wind (NJ)

## ■ 2023+

1. Avangrid Kitty Hawk (NC)
2. US Wind New Jersey (NJ)
3. Ørsted DWW Garden State Offshore Energy (NJ)
4. Dominion Energy Coastal Virginia (VA)
5. Equinor 520(MA)
6. Mayflower Wind 521 (Shell) (MA)
7. Vineyard Wind 522 (MA)
8. NY Bight Area (NY)
9. NY Bight Area (NY)

10. NY Bight Area (NY)

11. NY Bight Area (NY)

12. Wilmington West(NC)

13. Wilmington East (NC)

14. Grand Strand (SC)

15. Winyah (SC)

16. Cape Romain (SC)

17. Charleston (SC)

## 18. CALIFORNIA!!!

- 3 potential areas



# East Coast Lessons Learned

- Local infrastructure:
  - Need to develop port facilities for import & assembly
  - Need to train workforce
  - Need to import vessels (or construct them)
  - If domestic manufacture, logistics/infrastructure for transportation
- Construction Conditions
  - Weather
  - Boulder fields & scour
  - Marine protected species
  - Wrenches left in the turbine (whoops)





# 2020-2023 US West Coast

- CA = Renewables: 50%(2026), 60%(2030), 100%(2045)
  - Currently 32% from renewables
    - Onshore Wind
    - Hydro
    - Solar
  - BOEM soliciting call for lease area nominations & information now
- HI = 100% Renewable Energy by 2045
- OR = Failed Coos Bay OWF by Principle Power
- WA = Lower Wind Speeds / No Interest Currently

## Navy study of offshore wind farm sites

The U.S. Navy sent the Bureau of Ocean Energy Management this map in February. According to the Navy's assessment, large swaths of California's coast are deemed off limits to offshore wind farms.



## Fixed

- In less than 180' water depth
- Full survey
- Stakeholders
- Cost competitive
- 30 MW USA, US Department of Energy predicts 22 GW by 2030
- 15 GW EU, 25 GW by 2020

## Floating

- Greater than 180' water depth
- Geotechnical component smaller
- Differences view 15/20 miles & fisheries
- Costly (pre-commercial stage)
- 30 MW demonstration complete (Hywind Scotland)



# Floating future

- USA capacity 58% > 60 meters
- Europe & Global capacity 80% > 60 meters
- Potential floating EU estimated at 4000 GW
- Hywind Demonstration project:
  - Scotland 30 MW / 5 turbines at 300' to 400' water depth
  - Powering 20,000 households
- Cost reduced by 60-70% since first pilot
- Further cost reduction of 40 – 50% expected
- 9 floating projects planned for 2021-2023 (338 MW)

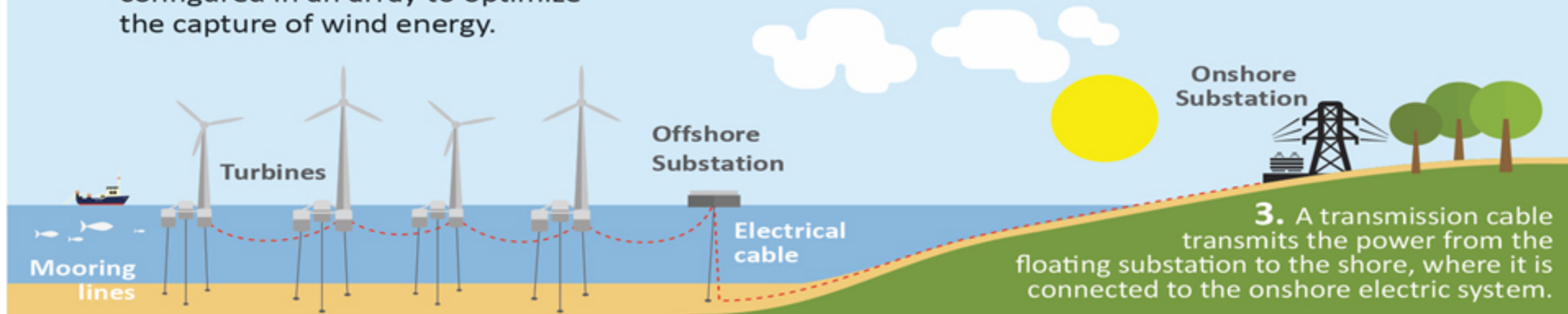


# BOEM Graphical Representation of a Floating Wind Project

**1.** Floating wind turbines are configured in an array to optimize the capture of wind energy.

**2.** Energy captured by the turbines is conveyed through a transmission line to a floating substation.

**3.** A transmission cable transmits the power from the floating substation to the shore, where it is connected to the onshore electric system.

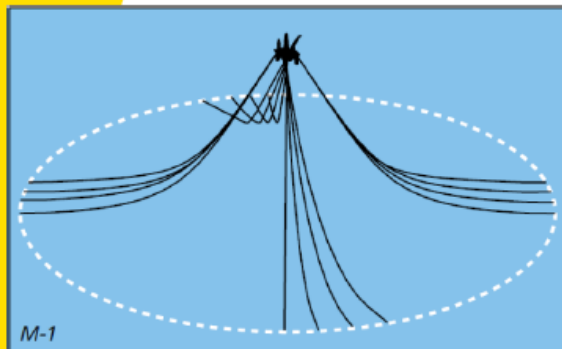


*Not represented here is the considerations for import/fabrication, construction/assembly, transportation, maintenance facilities.*

*Not to scale – typical expectation is for project to be >25 NM from shore. Cable catenaries between turbines, sub-station and to shore will be significant considerations.*

# Potential Anchoring Methods

## Catenary

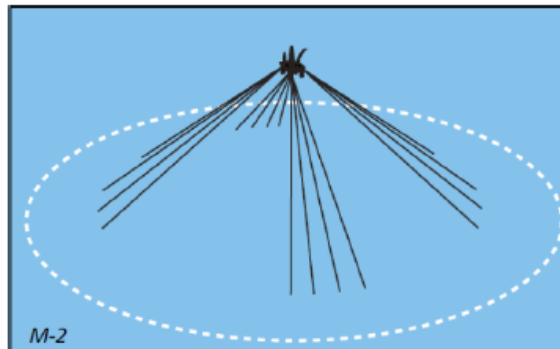


Restoring forces: weight

- + Easier installation
- + Damping effect: lower loads
- + Lower cost

- Significant spread/footprint
- Significant excursion

## Taut and semi-taut leg

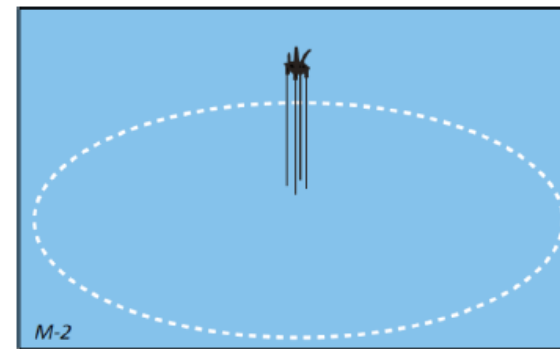


Restoring forces: elasticity

- + Higher loads in line
- + Larger units can be moored
- + Reduced excursion

- More expensive
- Medium footprint

## Tension leg platform (TLP)



Restoring forces: floating reaction/tension in tendons

- + Minimal footprint
- + Minimal excursion

- Foundation challenges
- Highest cost



# California Drivers

- August, California passed bill SB100 for 100% carbon-free electricity
- No existing renewable energy source in California can meet “duck curve” demand
- Federal, state, municipal, and private sectors involved
- Federal agencies already investigating & de-risking sites
- Large-scale projects possible using existing shore-side grid connections available (Morro Bay, SONGS, Diablo, & Redwood City)



# California Challenges

- Stakeholder engagement
- Navy & NOAA restricted areas
- Potential for impacts on commercial fishing
- Extraordinary water depth (~1500' to ~3000')
- Shipping traffic (near Channel Islands/SONGS)
- Port facilities need upgrading to support wind turbines
  - Hywind: Turbine size 803' total height!
  - Dry dock size, water depth, quayside, cranes, etc.
- Supply chain scaling up / installation vessel





# The 800 Pound Gorillas

- The four biggest obstacles to offshore wind development in California are conflicted use with:
  - US Navy ➔
  - NOAA Marine Sanctuaries
  - POLA/POLB Shipping Route conflicts
  - Commercial fishing conflicts



## Where would the wind farms go?

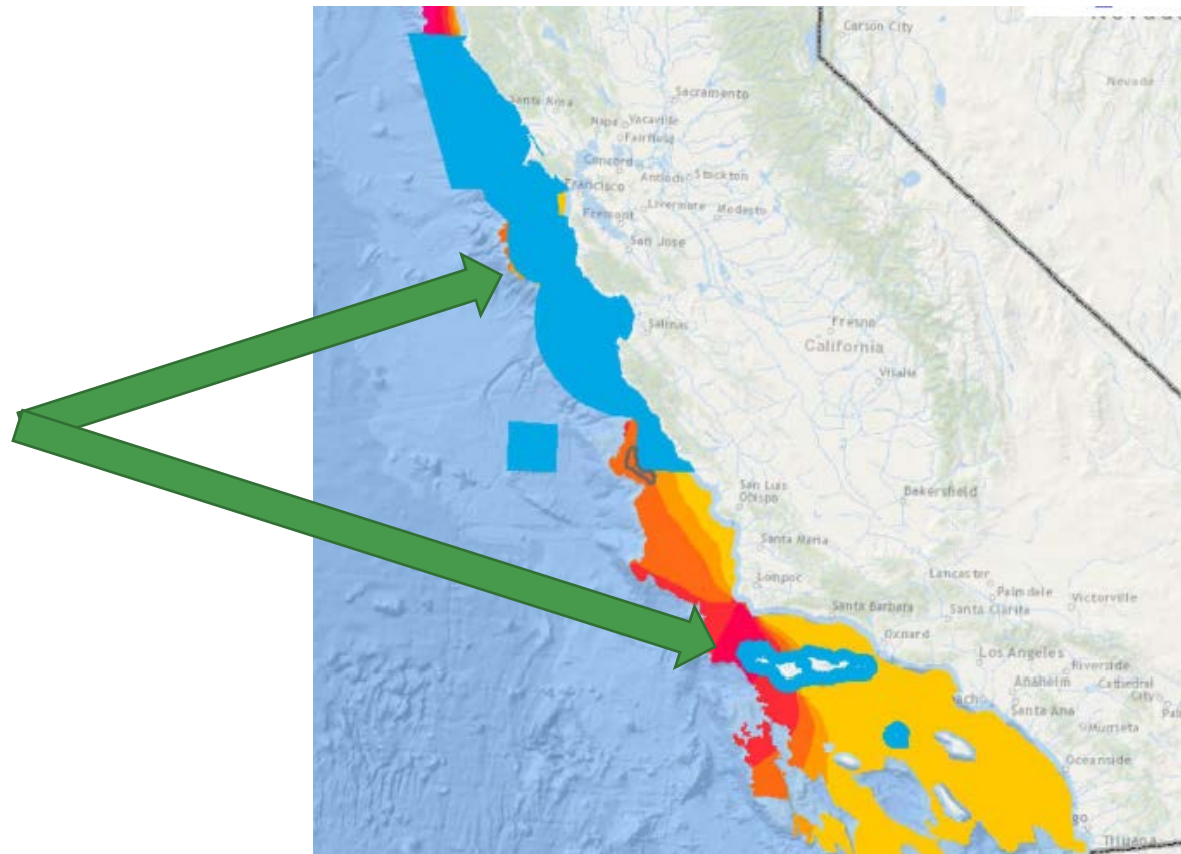
A U.S. Navy map shows that most of the federal waters south of Monterey are classified as wind exclusion zones, meaning they would be unfit for that type of energy development because of incompatibility with military activities. The Navy could decide to adjust the map to allow for wind farms in isolated areas.

- No restrictions
- Site-specific stipulations
- Wind exclusion
- Point Mugu Sea Range
- Special-use airspace
- National Marine Sanctuary
- County boundary

SOURCE: U.S. Navy

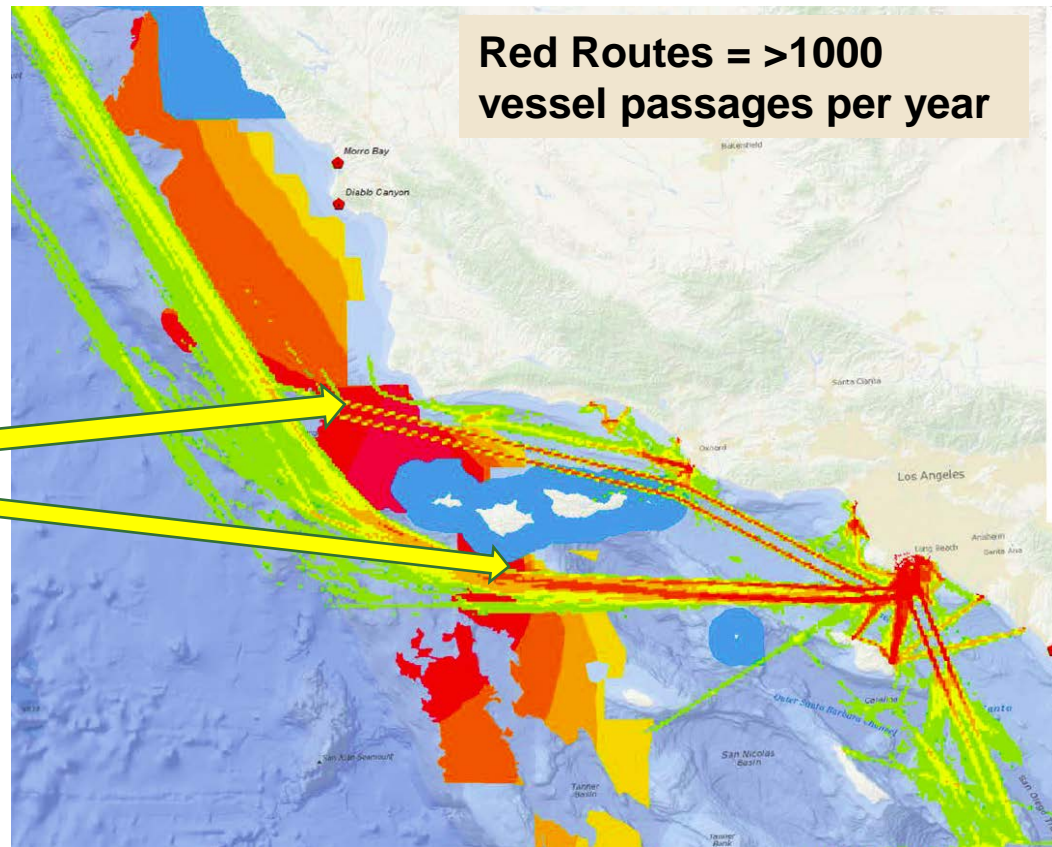
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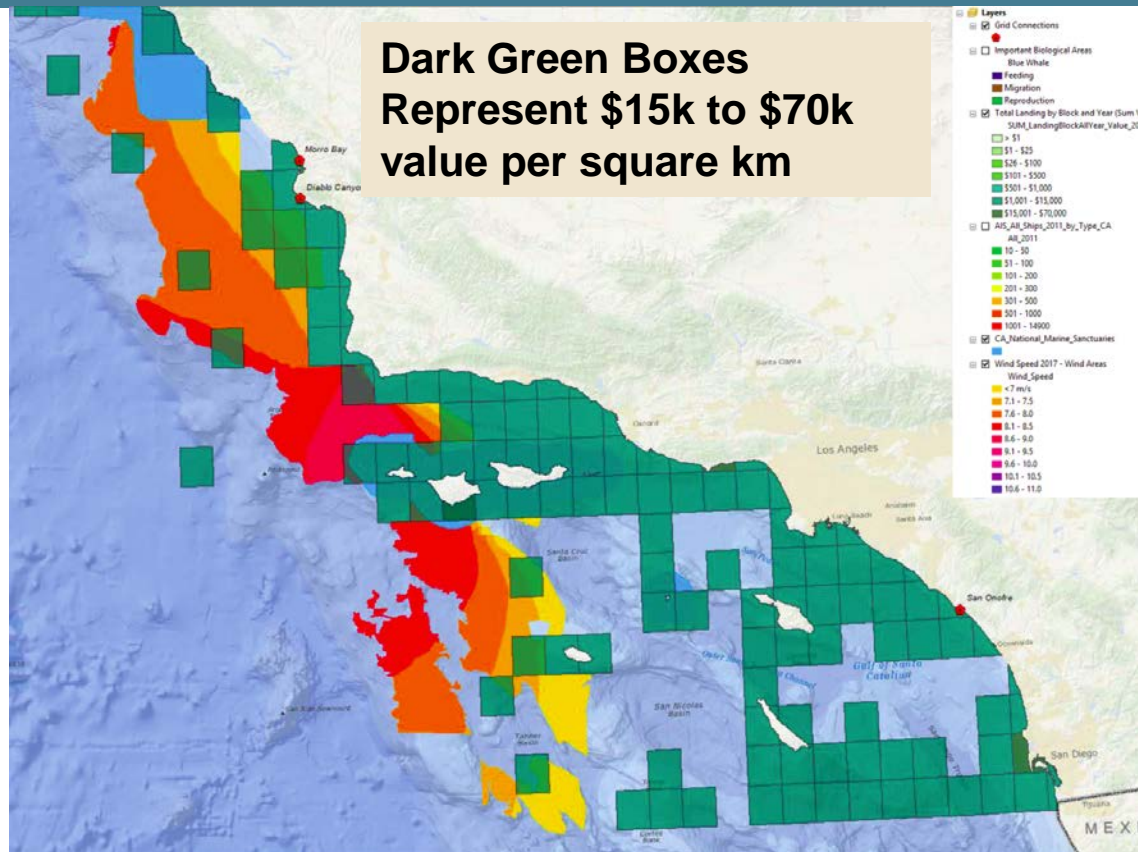
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# What's Happening In California?



- BOEM has organized a State Task Force for planning development  
<https://www.boem.gov/california/>
- Call for Information & Nominations went out October 19, 2018.
  - This is to seek stakeholder input on potential lease areas



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## Renewable Energy

- ▶ Rules Development and Interim Policy
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- ▶ Regulatory Framework
- ▶ National and Regional Guidelines
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- ▶ Partnerships
- ▶ Stakeholder Engagement
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  - Maryland
  - Massachusetts
  - New Jersey
  - New York
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## California Activities

### What's New?

#### Call for Information and Nominations

The Bureau of Ocean Energy Management (BOEM) published a Call for Information and Nominations (Call) on October 19, 2018 to obtain nominations from companies interested in commercial wind energy leases within the proposed areas off central and northern California.

In addition to nominations, BOEM seeks public input on the potential for wind energy development in the Call Areas. This includes site conditions, resources, and multiple uses in close proximity to, or within, the Call Areas that would be relevant to BOEM's review of any nominations submitted, as well as BOEM's subsequent decision whether to offer all or part of the Call Areas for commercial wind leasing.

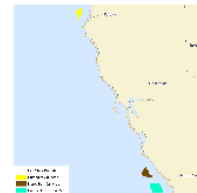
- California Call for Information and Nominations, Docket Number: 2018-0045
- Central California
- Central California, NOAA Chart
- Northern California
- Northern California, NOAA Chart

The Call is open for a 100 day comment period.

Docket Number: 2018-0045  
The comment period will close on January 28, 2019. All responses will be reported on <http://www.regulations.gov>.

Nominations should be postmarked no later than the date above and submitted in written form to the following address. In addition to a paper copy of the nomination, include an electronic copy of the nomination on a data storage device. BOEM will list the parties that submitted nominations and the location of the proposed lease areas (i.e., OCS blocks nominated) on the BOEM website after the 100-day comment period has closed.

Bureau of Ocean Energy Management  
Office of Strategic Resource Renewable Energy Section  
760 Paseo Camarillo, Suite 102  
Camarillo, California 93010



California Offshore Wind Gateway

[SIGN UP for BOEM California Offshore Renewable Energy News and Updates](#)

[SIGN UP for California Energy Commission Offshore Renewable Energy News and Updates](#)

# What's Happening In California?

- BOEM has organized a State Task Force for planning development  
<https://www.boem.gov/california/>
- Call for Information & Nominations went out October 19, 2018.
  - This is to seek stakeholder input on potential lease areas
- OPEN COMMENT PERIOD NOW!
  - Until January 28
  - <https://www.regulations.gov/>
  - Search: BOEM-2018-0045



The screenshot shows the regulations.gov website interface. At the top, there's a navigation bar with 'Home', 'Help', 'Resources', and 'Contact Us'. A search bar contains 'BOEM-2018-0045'. The main heading is 'Commercial Leasing for Wind Power Development on the Outer Continental Shelf (OCS) Offshore California - Call for Information and Nominations (Call)'. Below this, there's a 'Docket Folder Summary' section with a link to 'View all documents and comments in this Docket'. The 'Summary' section provides details about the BOEM invitation for wind leases. On the right, there's a 'Take a Tour!' button and a 'Sign up for Email Alerts' section showing '40 Comments Received'. Below that is the 'Agency Contact' information for Jean Thurston. At the bottom, the 'Primary Documents' section lists the main document with a 'Comment Now!' button, which is highlighted by a red arrow. The 'Supporting Documents' section shows 'No documents available'.

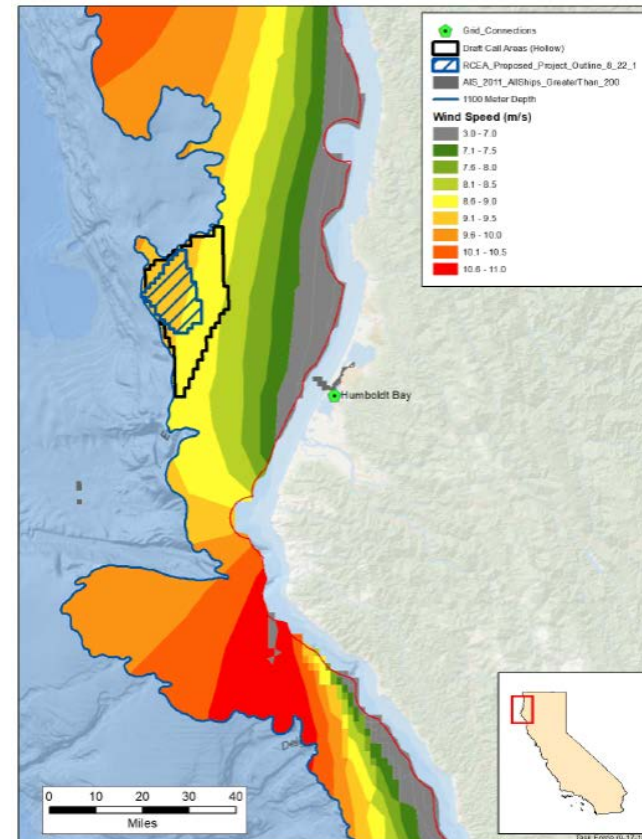
- 
- Legend**
- Proposed 1000 Year flood plain
  - Distance to Leveeling (meters) scale
  - Leveeling Levels (ft)
  - FEMA boundary
  - Wetland area boundary
  - Levee Construction
  - Section Key Boundary
  - Other Governmental Road
  - Abroad
  - Submarine cables
  - International boundaries
  - National boundaries
  - City





# Northern California

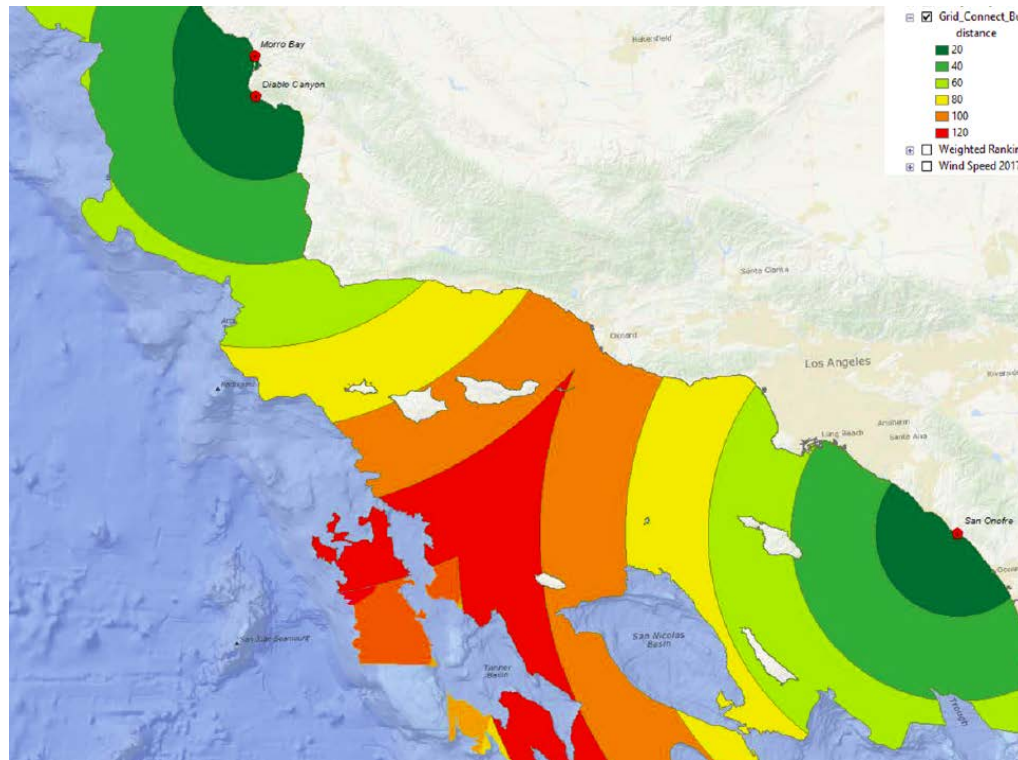
- 2018: Redwood Coast Energy Authority submitted an unsolicited lease application for a site off of Humboldt Bay
  - 120-150 MW (5-15 turbines)
  - Strong winds for energy generation
  - Humboldt Bay has a deep water port
- Since submission, other private sector developers have expressed interest in this project – therefore, BOEM will move to competitive lease via auction



# Southern California

- To date, no organization has submitted an unsolicited lease bid.
- Two European developers (Ørsted and Equinor) have verbally expressed interest to BOEM about developing these areas.
- San Onofre Nuclear Power Plant's grid connection could receive power from over 200 offshore wind turbines
- Likely Southern California will be the last location to develop due to Navy, shipping and Sanctuary constraints

## Distance to Onshore Grid Connection



# What's Happening In California?

- California Energy Commission is fostering communication between stakeholders and coordination.
  - Workshops
  - Task Force meetings
  - [https://www.energy.ca.gov/renewables/offshore\\_energy/documents/](https://www.energy.ca.gov/renewables/offshore_energy/documents/)
- California Offshore Wind data Gateway
  - Stakeholder database hosted on <https://caoffshorewind.databasin.org/>



The screenshot displays the California Offshore Wind Energy Gateway website. At the top, the header includes the FUGRO logo, the title "California Offshore Wind Energy Gateway", and the subtitle "In support of the Intergovernmental Renewable Energy Task Force". A search bar is located on the right, and a "powered by DATA BASIN" logo is at the bottom right. The main navigation bar contains five tabs: "Get Started", "Explore", "Create", "Community", and "My Workspace".

The "Explore" tab is active, showing a large image of a wave. To the left of the image are three buttons: "What is the California Offshore Wind Energy Gateway?", "What can I do?", and "How do I start exploring?". To the right of the image is a text block that reads: "The Offshore Renewable Wind Energy Gateway assembles geospatial information on ocean wind resources, ecological and natural resources, ocean commercial and recreational uses and community values. This information will help identify areas off of California that are potentially suitable for wind energy generation." Below this text is a "read more" link. Below the main image are four smaller images with titles: "California Marine & Coastal Energy", "California Marine & Coastal Management", "California Marine & Coastal Ecology and Natural Resources", and "California Marine Fishing and Traditional Uses".

At the bottom, there are two sections: "Featured Items" and "BOEM California Off-Shore Wind Call Areas". The "Featured Items" section contains three items: "California Offshore Wind Energy - Key Planning Data and Information", "CA Offshore Wind Energy: Biological Habitat Areas", and "CA Offshore Wind Energy: Biological Areas for Marine Bird Species". The "BOEM California Off-Shore Wind Call Areas" section contains a map of the California coast showing wind call areas.

# Are California Ports Ready?

- The short answer is: **No**
- Study commissioned by BOEM identified that current port infrastructure is not adequate to support the importation, fabrication, assembly, transit, and installation of offshore wind structures for California
- There looks to be considerable opportunity available, although San Francisco Bay ports likely will be challenged by the Golden Gate Bridge
- 50% of offshore wind project capital costs are operations and maintenance – therefore there are huge workforce opportunities available



## What else should we know?

- BOEM's selection process is based on highest bidder. Last round of lease sales in December generated \$405M for federal government (average \$200/acre)
- Unlike the east coast (with numerous large areas that can be developed), California will likely only have 3-5 lease areas in the foreseeable future
- Although BOEM will set regulations and require investigations/studies, an Environmental Impact Report, etc. – they will not set regulations for stakeholder engagement/participation, local content, foreign/domestic ownership, etc.
- The fundamental driver for the developer is establishing a Power Purchase Agreement with a power utility. This is a long-term agreement to buy power from the developer and generally is required as surety for the capital loan.

# Sources

- Bureau of Ocean Energy Management
- California Energy Commission
- Offshore Business Network
- Trident Wind
- Redwood City Energy Commission
- Ørsted
- Equinor
- National Renewable Energy Laboratory, Walt Newal, presentation July 11, 2018, Houston.
- U.S. Department of Energy report on offshore wind energy  
[https://www.energy.gov/sites/prod/files/WindVision\\_Report\\_final.pdf](https://www.energy.gov/sites/prod/files/WindVision_Report_final.pdf)
- Fugro knowledge base, Global offshore and onshore geotechnical and survey services



Thank-you for your time.

Now go submit a comment!!

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