Offshore Wind on California's North Coast

Schatz Energy Research Center

Introduction to Offshore Wind
September 14, 2020

Presented by Arne Jacobson
Schatz Energy Research Center

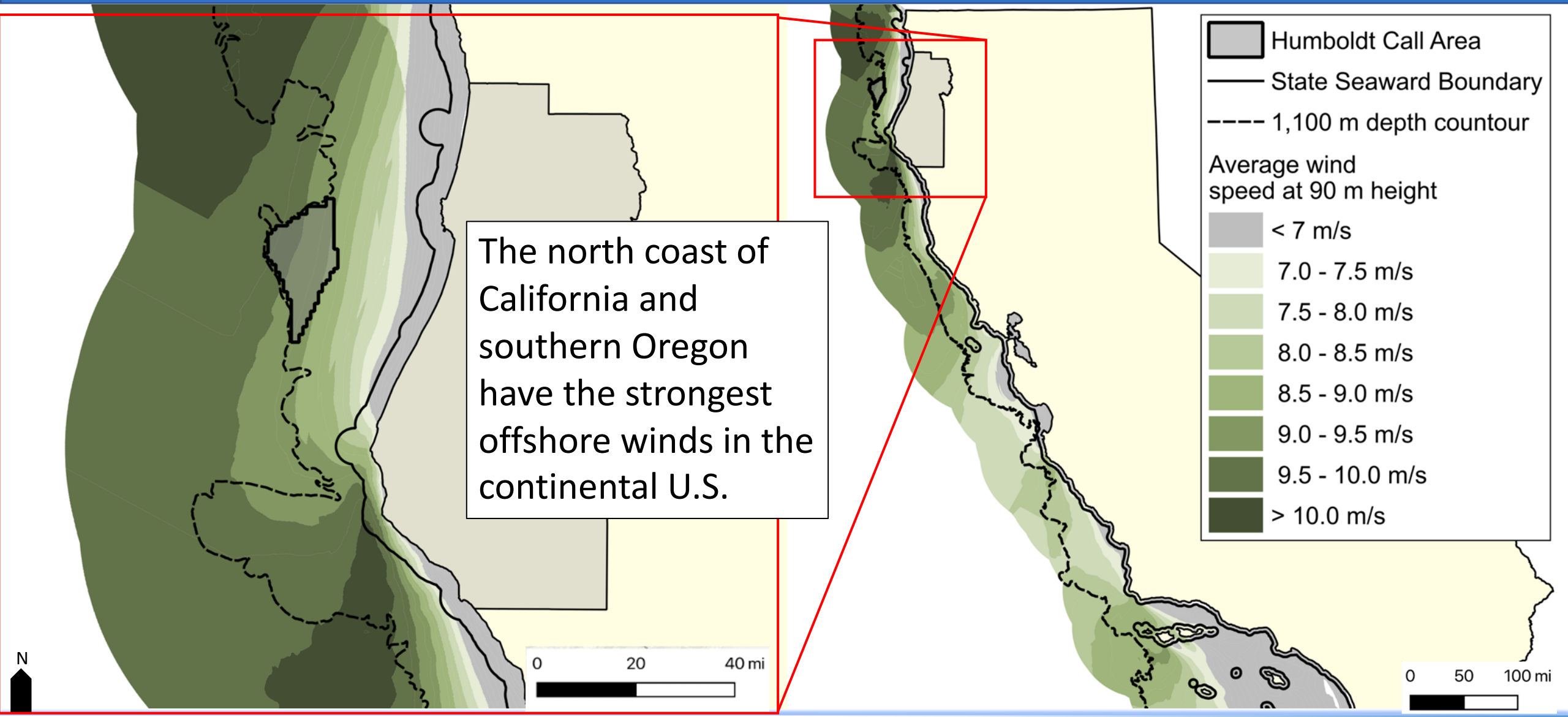
Photo credit: Maia Cheli

Addressing Climate Change Requires Urgent Action

- Climate change is a reality, and greenhouse gas emissions from energy use are a primary cause.
- Urgent action is need to reduce GHG emissions and increase resilience here on California's north coast and around the world.
- California has set aggressive climate and clean energy targets.
- Offshore wind energy could be part of the solution.

The LNU Lighting Complex fire burns a home near Vacaville on August 19, 2020.
Source: https://www.sfgate.com/california-wildfires/article/Vacaville-wildfire-threatens-over-homes-Winters-15495663.php#photo-19830959

The North Coast Offshore Wind Resource is Enormous



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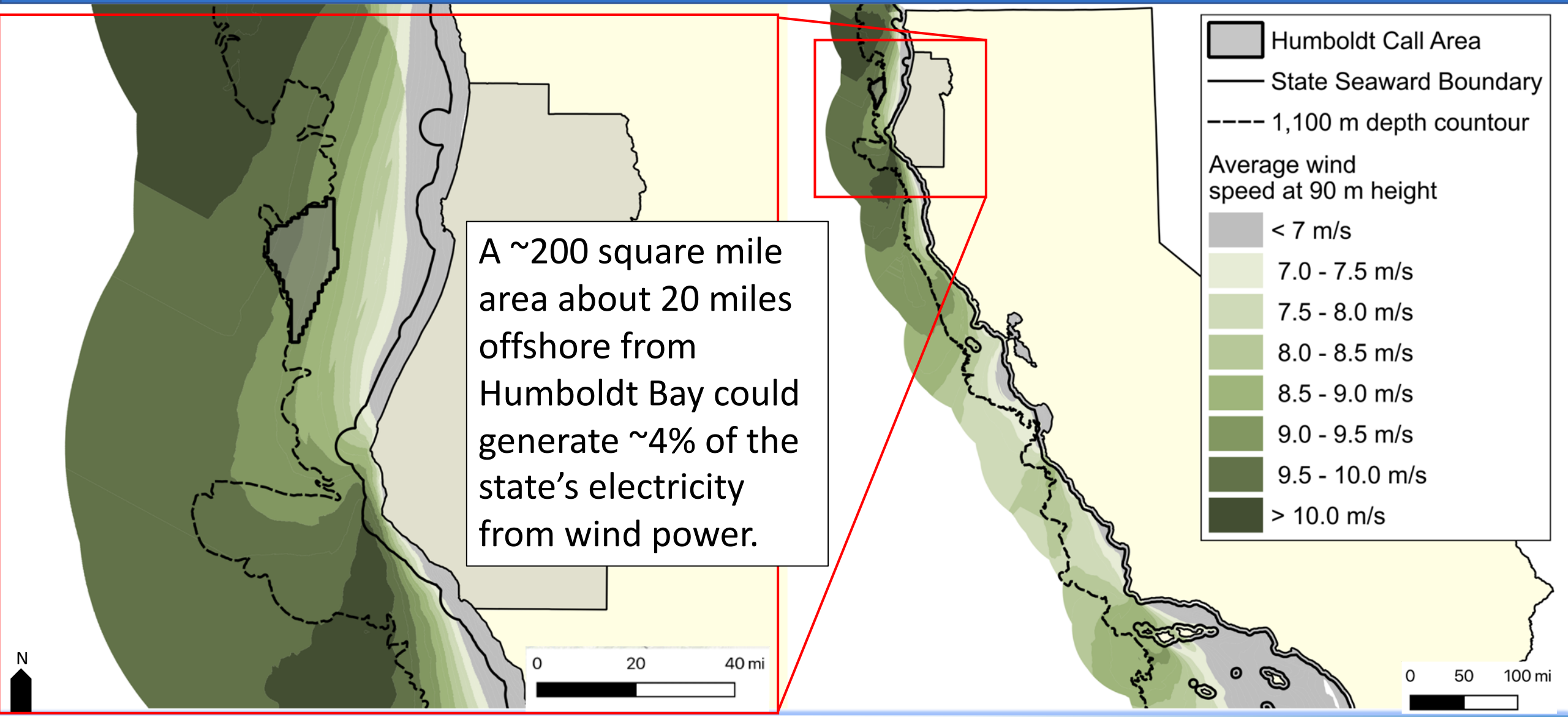


Offshore Wind Development Requires Innovation

- Offshore wind development on the north coast would represent a significant innovation.
- It could be the first offshore wind farm along the Pacific Coast of the Americas.

Image source: https://www.equinor.com/en/how-and-why/innovate/the-hywind-challenge.html

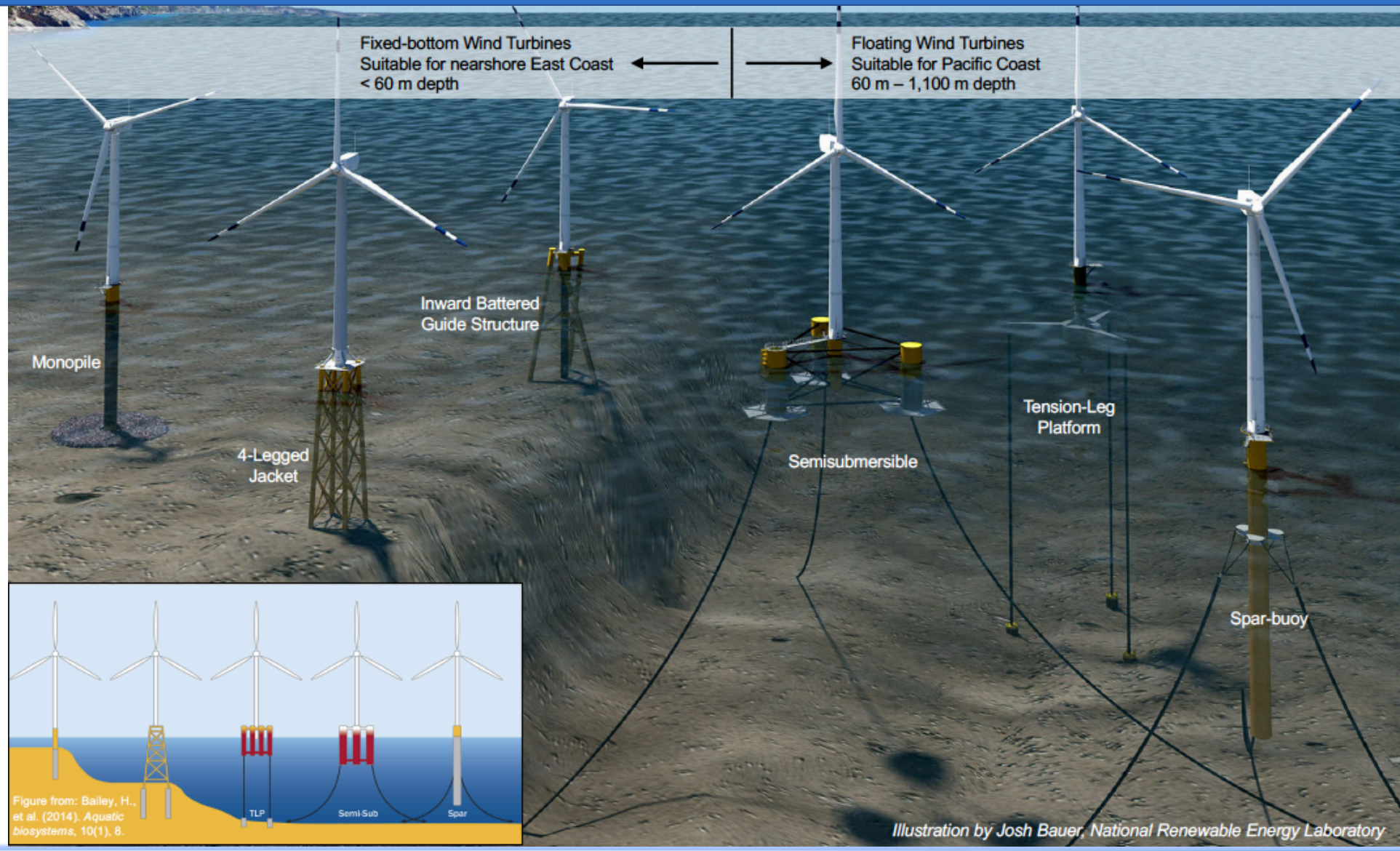
Floating platform offshore wind systems

- Because of deep ocean waters along the U.S. West Coast, offshore wind would need to use floating platforms.
  - Most of the global offshore wind industry is based on fixed bottom foundations, and most installations are in Europe and Asia.
  - Floating platform systems are an emerging technology; they account for <1% of global offshore wind installed capacity.

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

Offshore wind installation approaches

There are multiple fixed-bottom and floating-platform designs for mounting offshore wind turbines

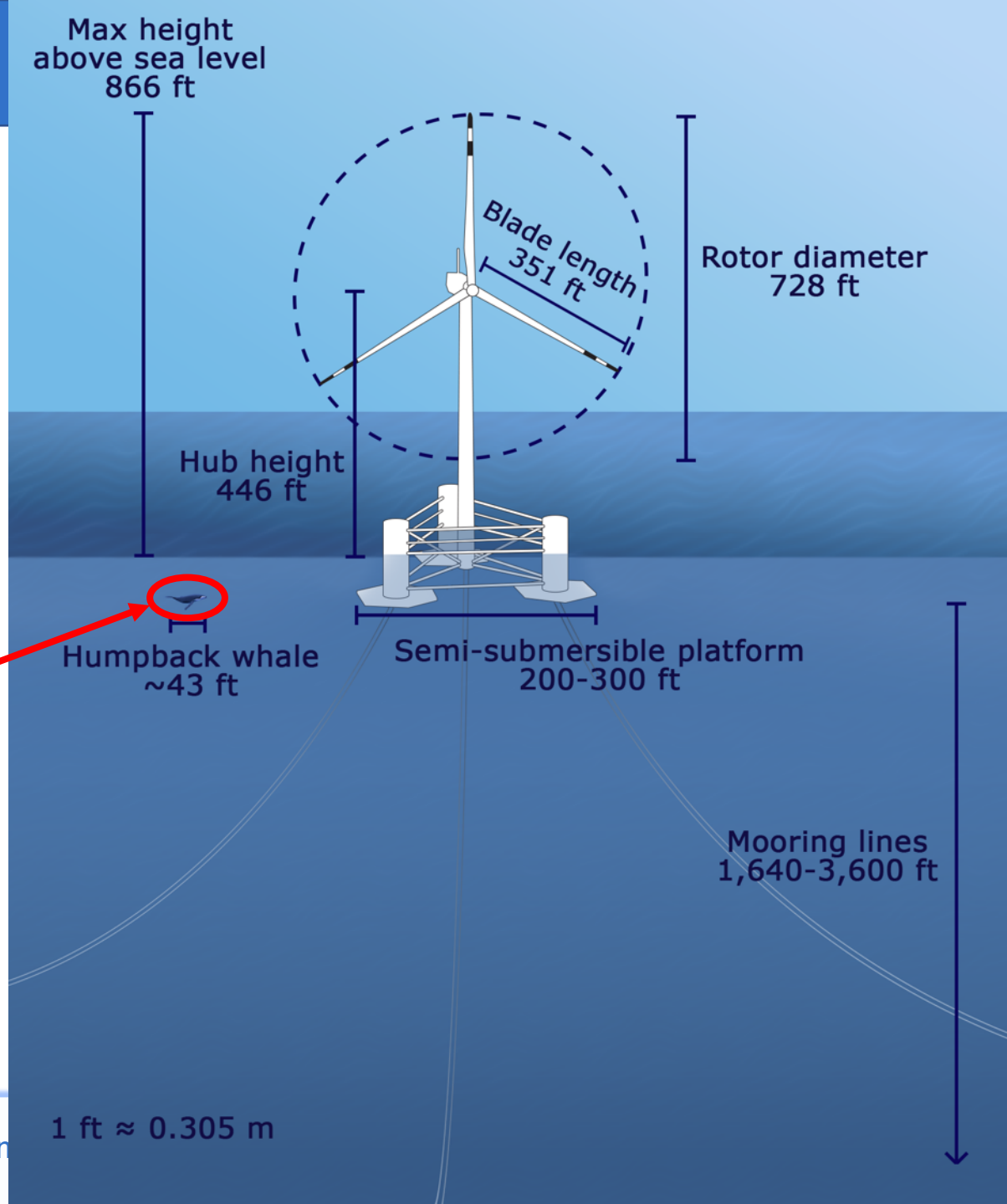


Offshore Wind Turbine Size

Offshore wind systems are very large

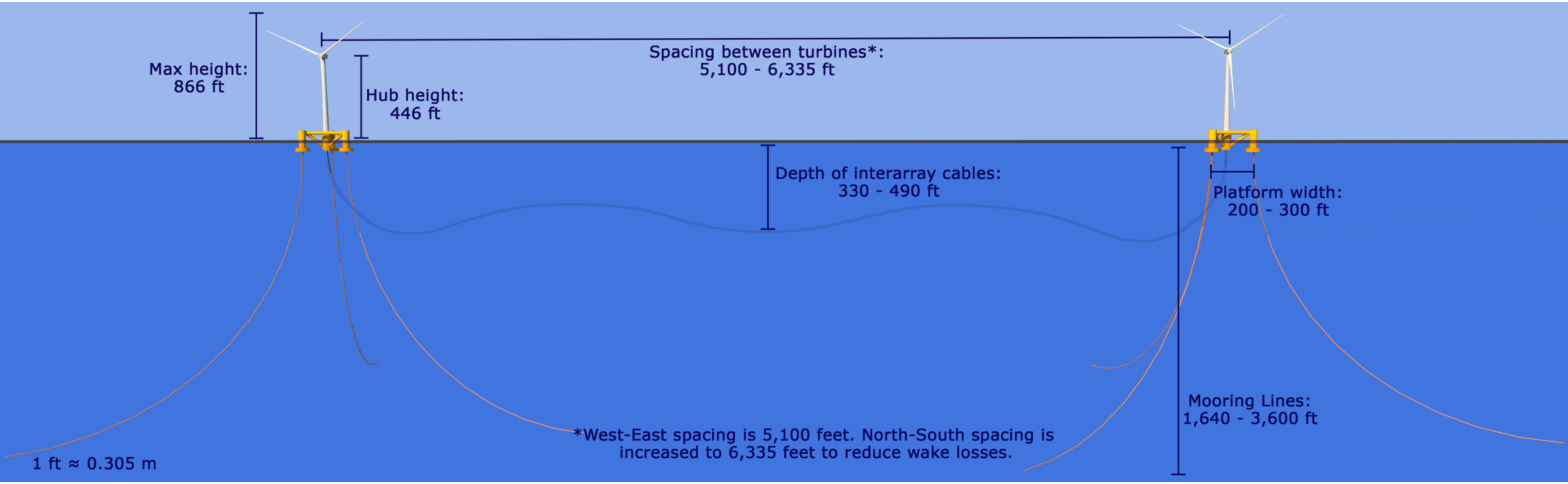
(the turbine hub for this 12 MW turbine is about 450 feet above the ocean surface)

Humpback whale (included for scale)



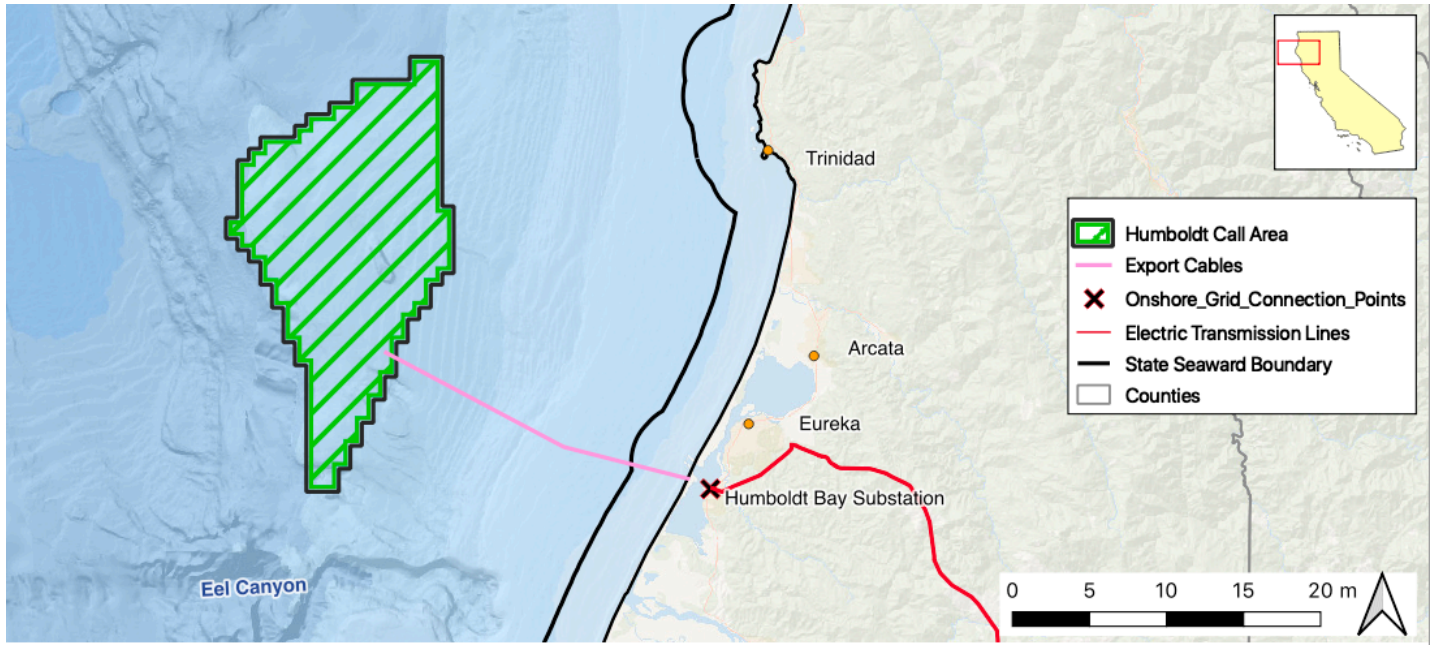
Offshore wind turbine spacing

The turbines may be separated by a mile or more in order to avoid having the wake from one turbine interfere with the available wind at the next one.



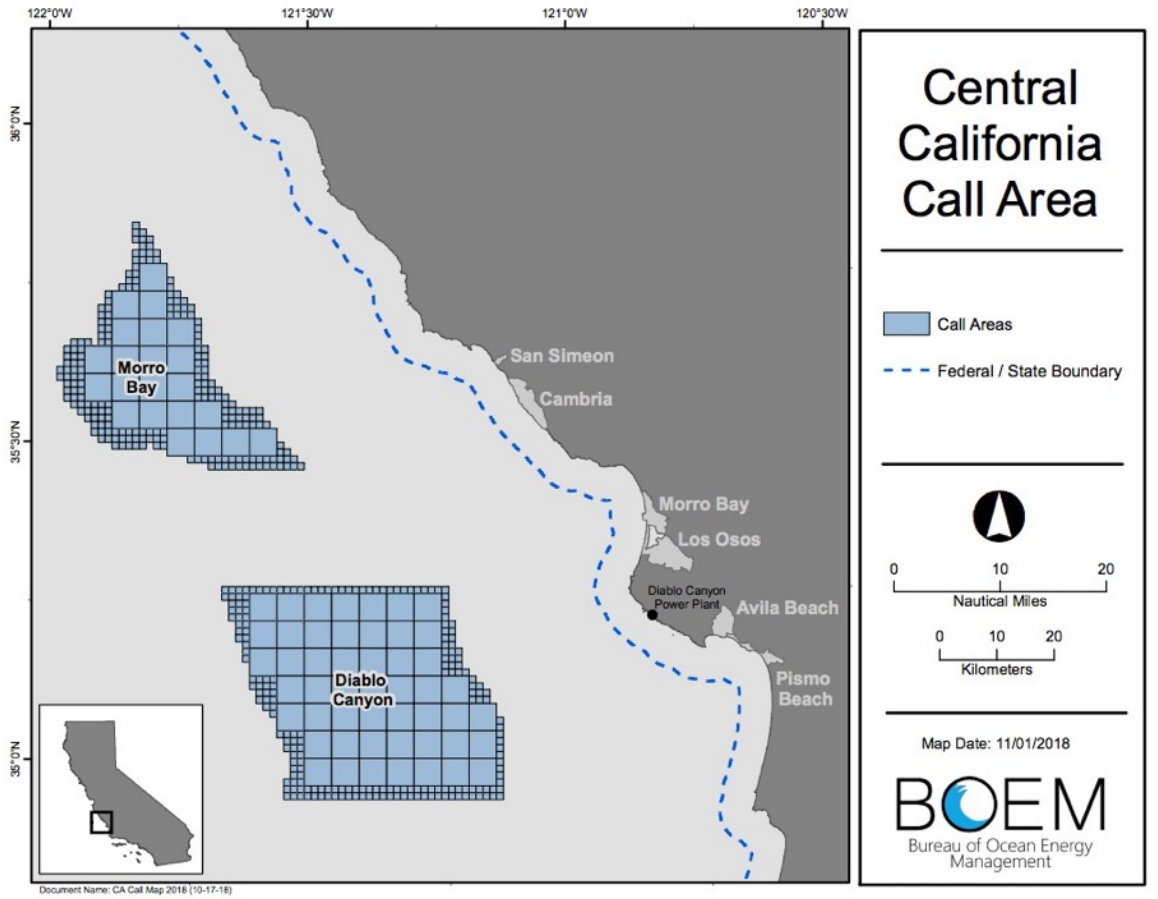
Offshore wind development timeline

- The process of developing offshore wind project is complex and involves numerous permits from multiple federal, state, and local agencies.
- At this stage, the Bureau of Ocean Energy Management (BOEM) has designated a call area for an offshore wind leasing process, but the lease auction has not occurred yet.
- After the “Humboldt Call Area” lease auction occurs, it may take the developer(s) 5-7 years (or more) to receive all permits and build the wind farm(s).



Can offshore wind be developed elsewhere in California?

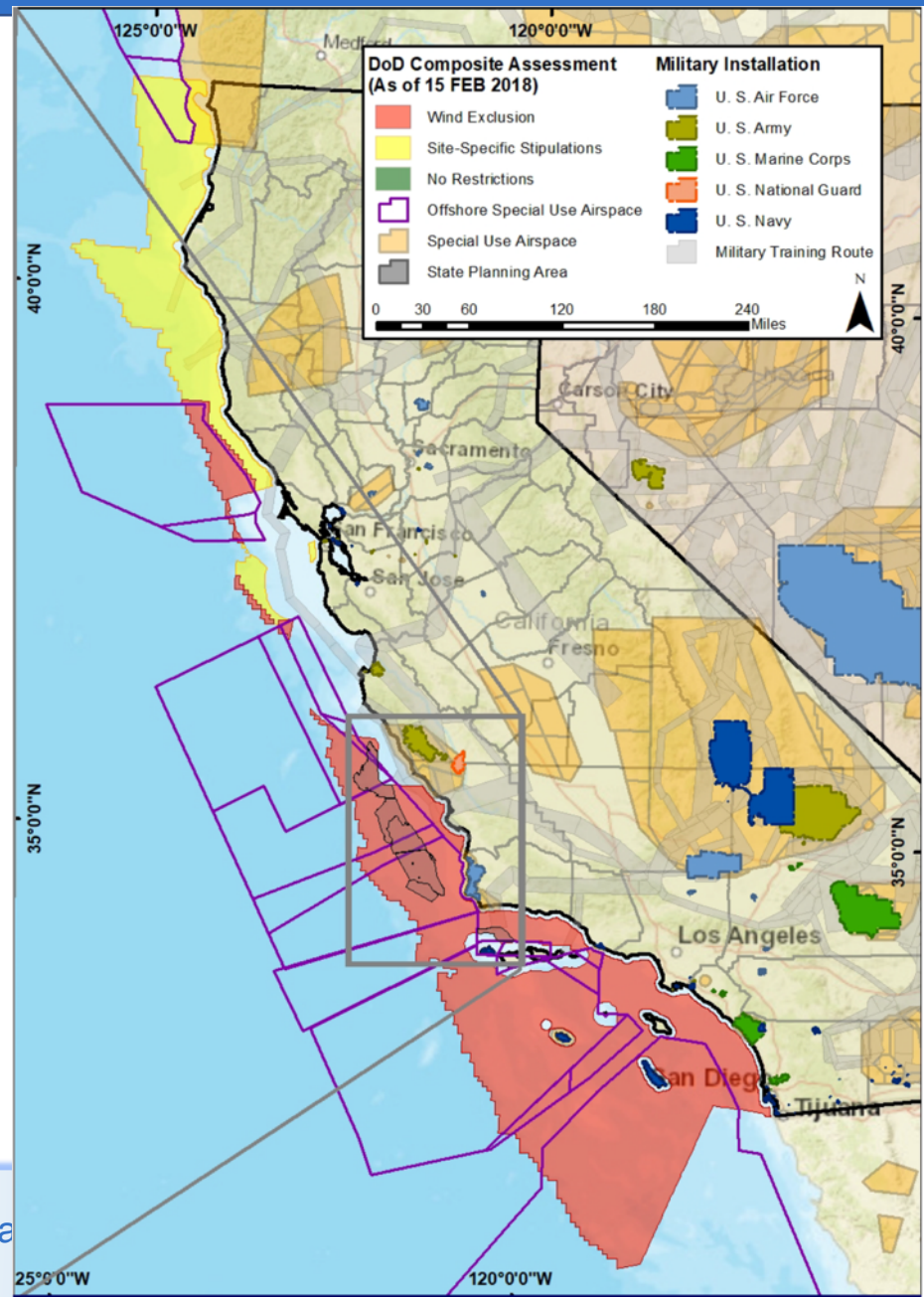
- BOEM has also identified two offshore wind call areas in central California (Morro Bay and Diablo Canyon).
- Offshore wind development in those regions has some advantages (proximity to electric load centers; better transmission infrastructure)



Source: https://media1.fdncms.com/ntslo/imager/u/original/8561288/news2-1-37dee6960592d9d1.jpg

Can offshore wind be developed elsewhere in California?

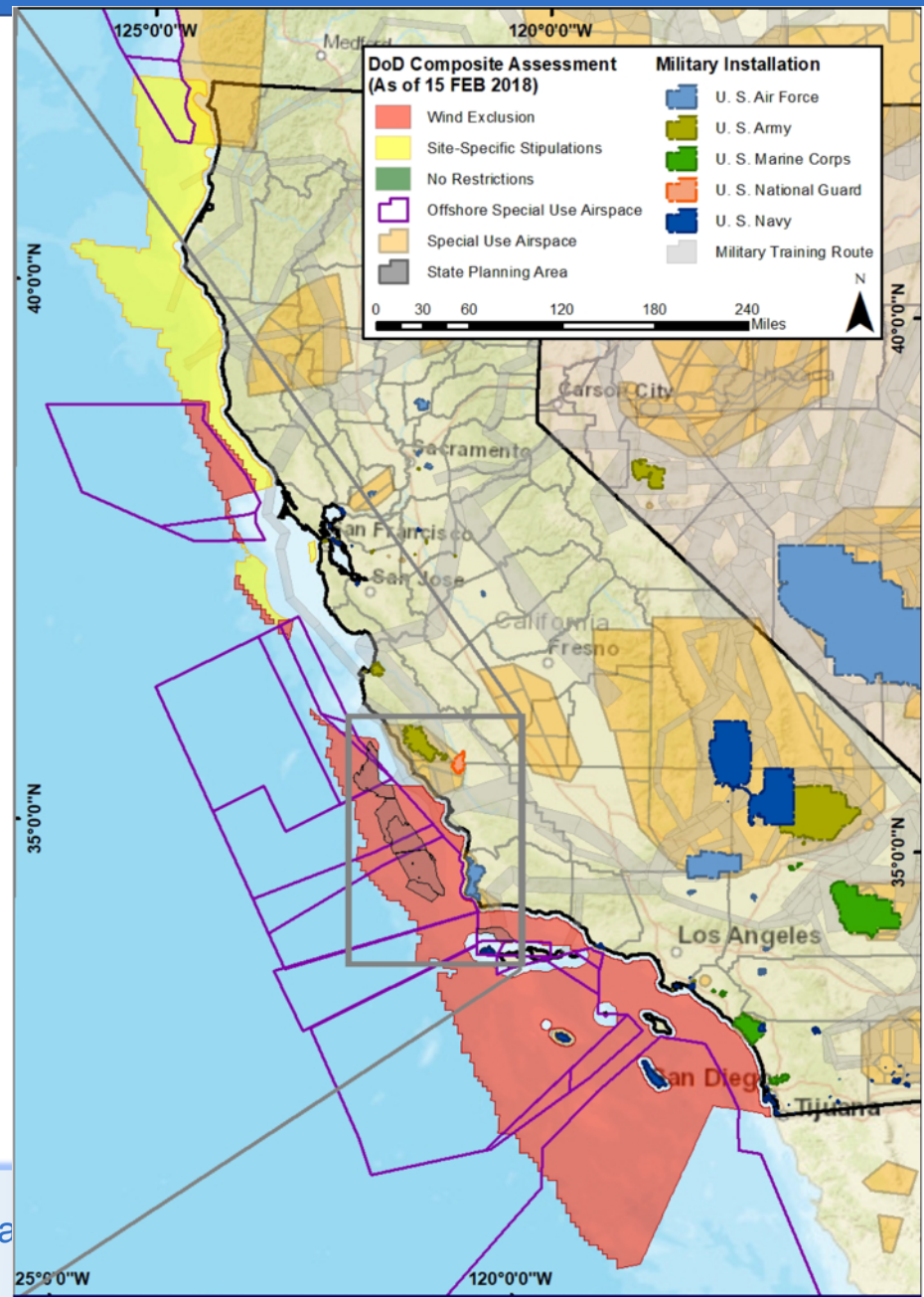
- BOEM has also identified two offshore wind call areas in central California (Morro Bay and Diablo Canyon).
- Offshore wind development in those regions has some advantages (proximity to electric load centers; better transmission infrastructure)
- However, the potential to proceed is currently limited by Department of Defense concerns related to military mission compatibility.



Offshore wind and military mission compatibility

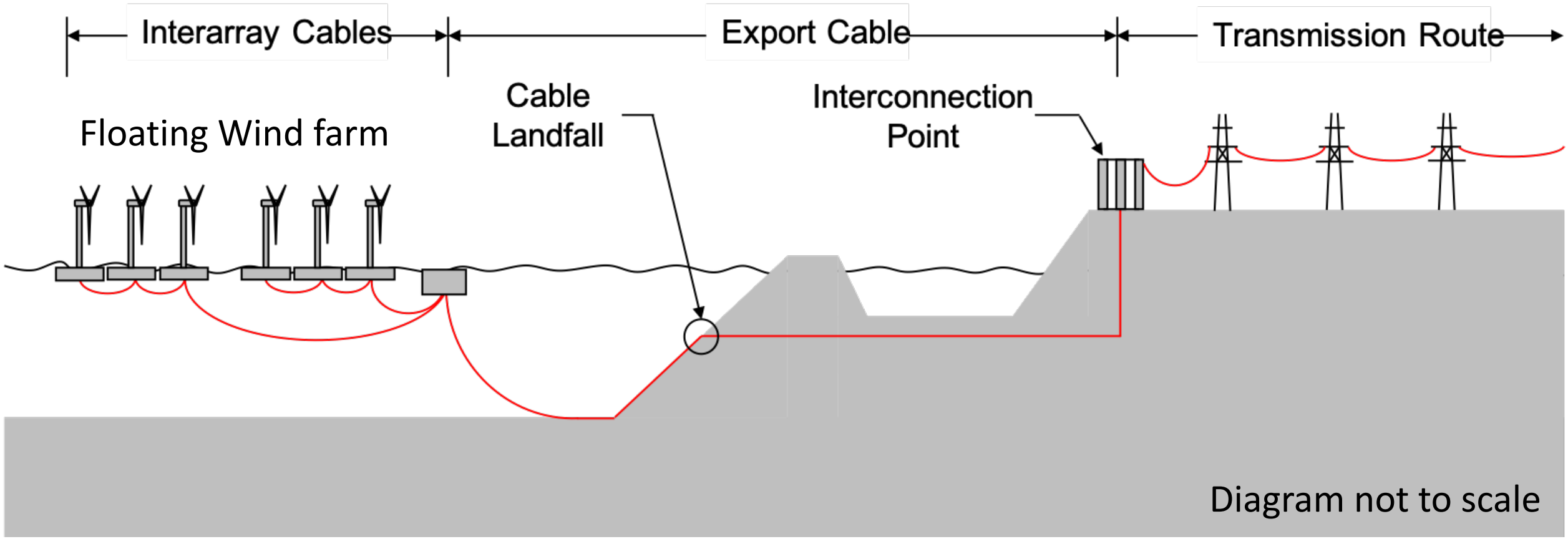
After reviewing a report from our team regarding potential scenarios for offshore wind development in the Humboldt Call Area, a Department of Defense representative provided the following response:

The *"…DoD Regional Offshore Team has review[ed] the report and continue[s] to find that offshore wind development within the Humboldt Call Area can be compatible with DoD's mission…"*

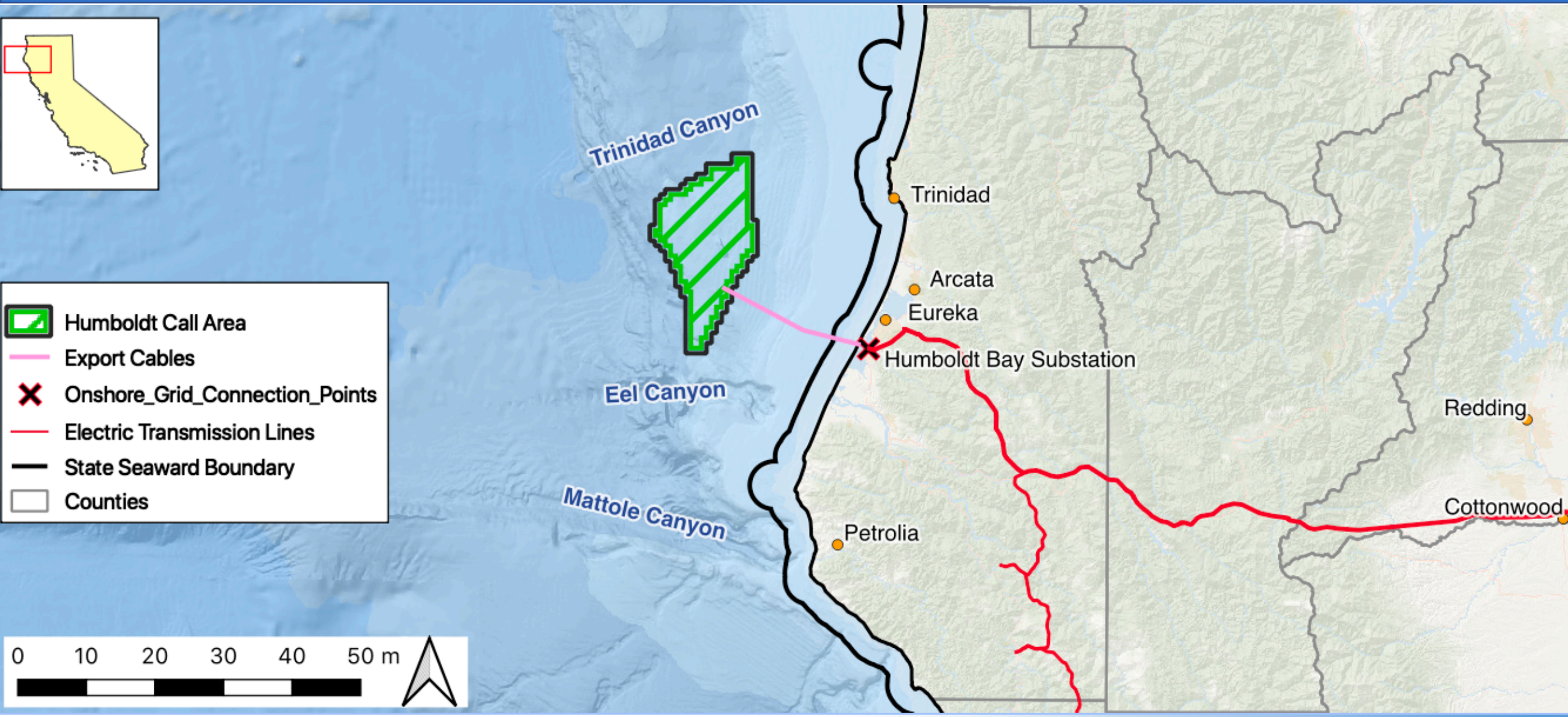


Floating offshore wind system elements

There are offshore and onshore elements to offshore wind systems.



Potential North Coast Offshore Wind Configuration



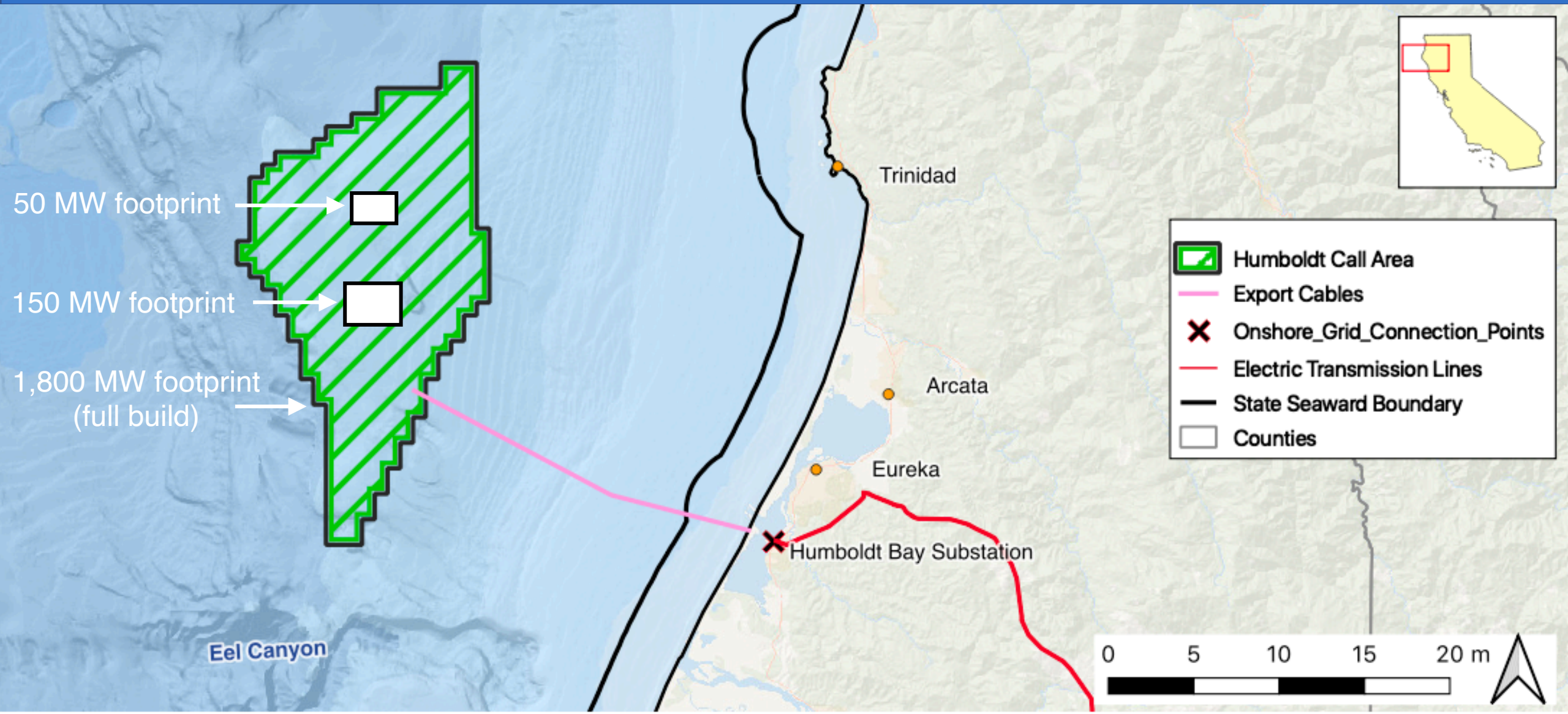
Our Team's Study Scenarios

Over the past 18 months, we have analyzed offshore wind using three scenarios representing different scales of development and transmission options.

Location	Description	Wind Farm Size
Humboldt Call Area	Pilot scale	50 MW
	Small commercial	150 MW
	Full build out	1,800 MW

Scale is a key theme when considering offshore wind. Larger scale deployments may be needed to enable economic viability, and larger scale projects provide greater climate change mitigation and economic development benefits. At the same time, larger scale deployments create more challenges in areas such as local environmental impact and conflicts with existing uses.

Our Team's Study Scenarios



Our Team's Study Scenarios

Studying three scales of development and transmission options:

Location	Description	Wind Farm Size	Fraction of Humboldt County Electric Load	Possible Transmission Routes
Humboldt Call Area	Pilot scale	50 MW	25%	• Overland transmission to the east and/or south • Subsea transmission south
	Small commercial	150 MW	75%	
	Full build out	1,800 MW	9x larger	

Off-Shore Wind Feasibility Analysis Research Topics

Funded by Bureau of Ocean Energy Management (BOEM)

- Resource assessment
- Grid compatibility
- Subsea cable
- Economic analysis

Funded by California Ocean Protection Council (OPC)

- Environmental impact
- Port infrastructure
- Stakeholder engagement
- Policy analysis

Funded by California Governor's Office of Planning and Research (OPR)

- Military compatibility
- Geologic / seismic
- Subsea cable environmental

Off-Shore Wind Feasibility Analysis Research Topics

Funded by Bureau of Ocean Energy Management (BOEM)

Focus for today's webinar

- **Resource assessment**
- **Grid compatibility**
- **Subsea cable**
- **Economic analysis**

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Public Webinar Series to Discuss Findings

Sept 14: Energy Production and Delivery and Economic Development

Presenter: Schatz Energy Research Center

Sept 21: Ecological and Geological Environment

Presenters: H.T. Harvey Ecological Consultants

Geology Department, Humboldt State

Sept 28: Port and Coastal Infrastructure

Presenters: Mott MacDonald, Coastal Engineers

Oct 5: Community Perspectives on Regional Impacts and Opportunities

Presenter: Environmental Science & Management, Humboldt State

Oct 12: Reflections and Next Steps

Presenters: Schatz Energy Research Center

State and Federal Agency Representatives

Each session will include:

- Presentation of research results
- Panel discussion with experts
- Dialogue with audience

Acknowledgments

Project Funders

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OCEAN PROTECTION COUNCIL

Governor's Office of Planning and Research

Team Members

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Navy Region Southwest

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Photo credit: Maia Cheli