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Offshore wind lease areas in California: criteria for site selection in the near term

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3rd March 2017




Classification: Open



9 February 20




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Offshore wind projects delivering up to 1100 MW

* All capacity figures on 100% basis

Sheringham Shoal	Dudgeon	Arkona
		
In operation	In construction	In construction
317 MW	402 MW	385 MW
2012-	2017	2019

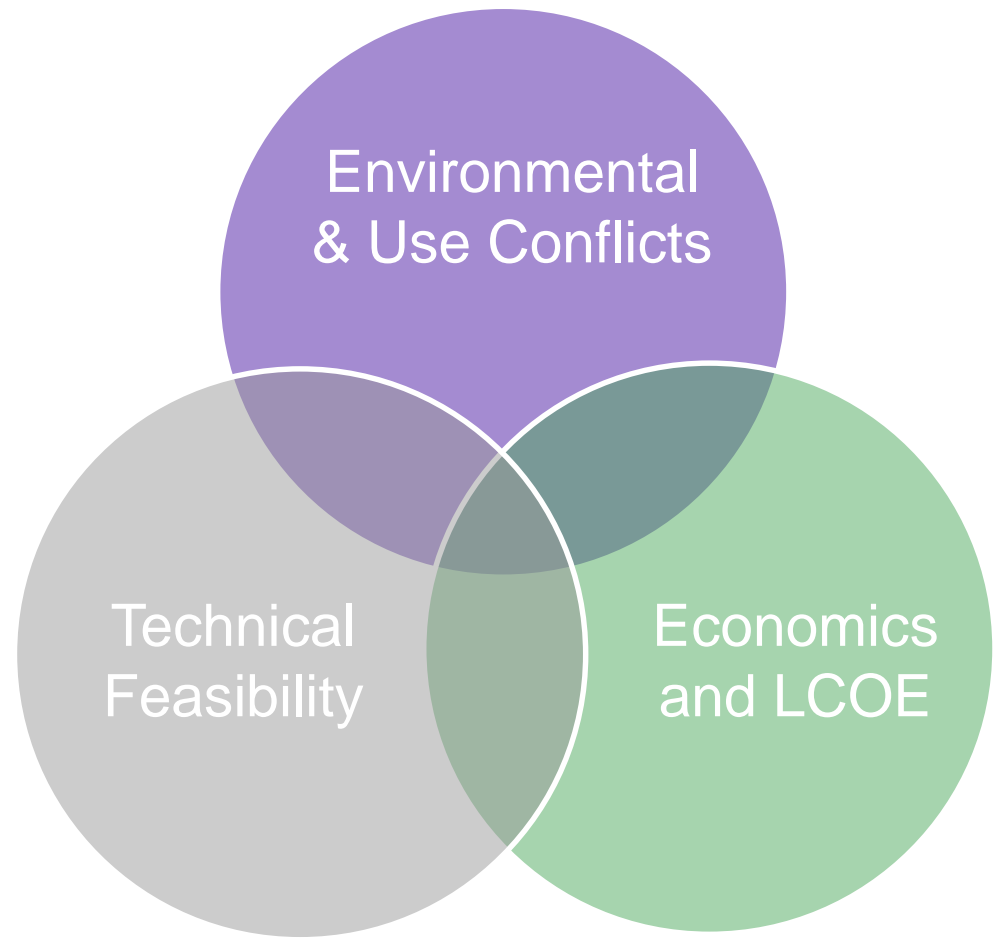
Dogger Bank	New York
	
Consented	In development
4 x 1200 MW	1000 MW
2020-	2025

Hywind Demo 2.3MW	Hywind Scotland 30MW	Utility Scale Hywind
		
©Hywind Hagen/Statoil		Alan O'Neill/Statoil
2009	2017	2020+



Site selection criteria

- Safe to construct and operate
- Safe for other users
- Lowest environmental impacts and use conflicts
- Lowest technical challenges
- Acceptable wind, economics and Levelized Cost of Energy (LCOE)
- Grid connection and Power Purchase Agreement (PPA) opportunities



Phased 'zone appraisal' approach

Northern California

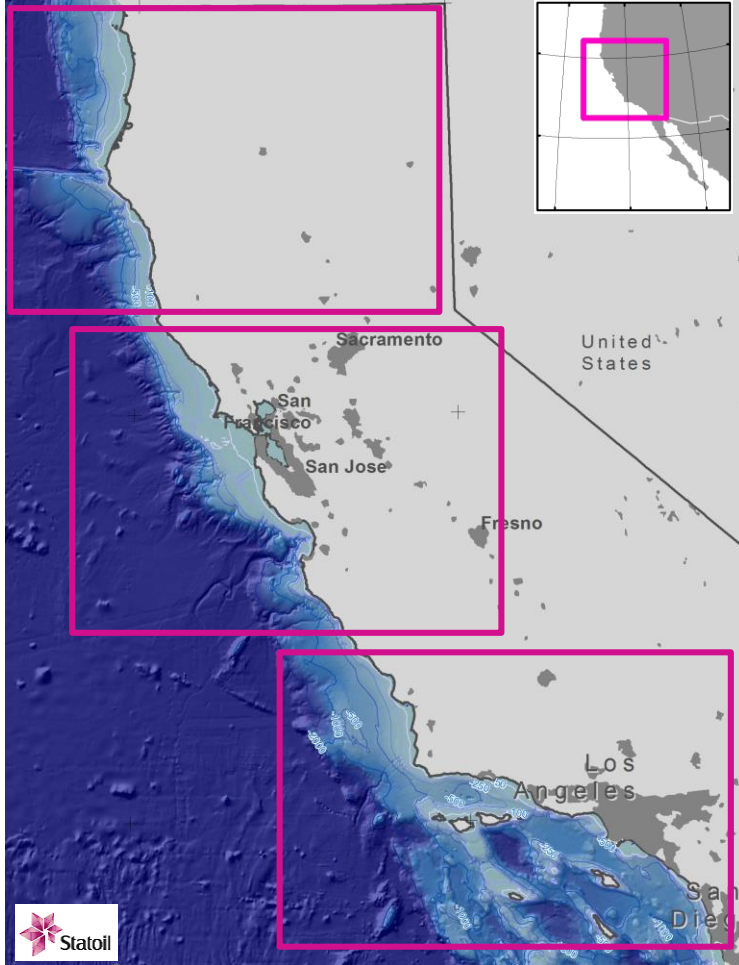
- Very good wind resource, suitable water depths
- Smaller market, limited grid to other markets
- Potential for the longer term

Central California

- Good winds, close to markets
- Potential permitting challenges
- Potential for medium term

Southern California

- Good wind resource in places
- Close to the market and grid infrastructure
- Permitting opportunities in the right areas



Environmental

- Ornithology
- Marine mammals
- Fish & shellfish
- Benthic ecology
- Marine ecology
- Marine protected areas, protected species
- Marine physical processes
- Marine sediment & water quality

Use conflicts

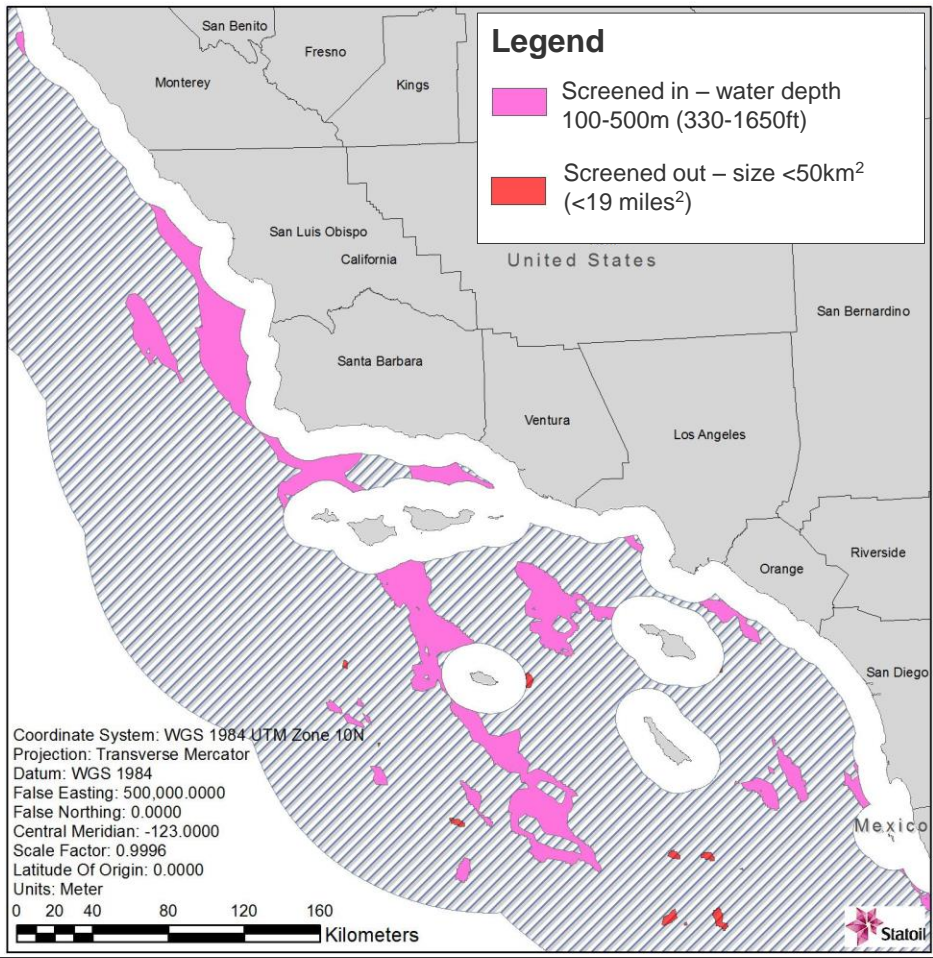
- Shipping & Navigation
- Military
- Recreational shipping, fishing, tourism, visual
- Commercial fisheries
- Oil & gas, aggregates, mining, renewables
- Aviation
- Tribes, cultural
- Radar

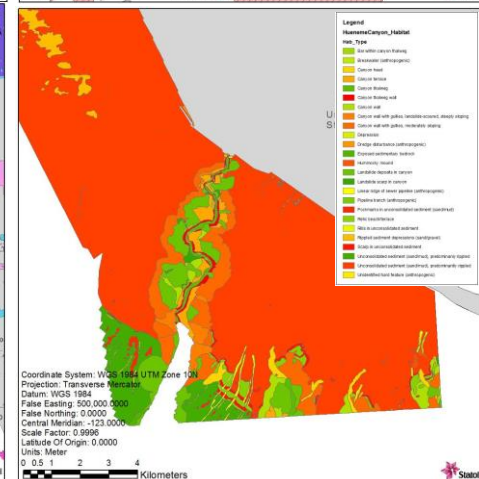
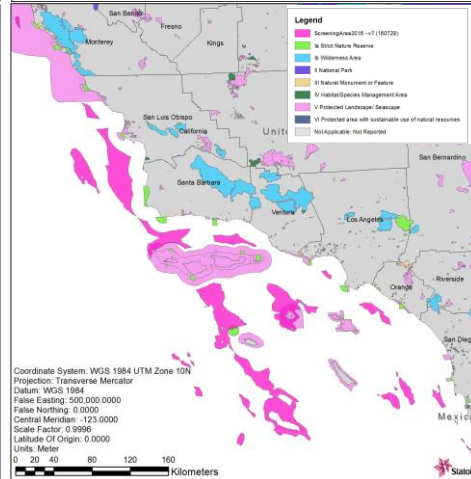
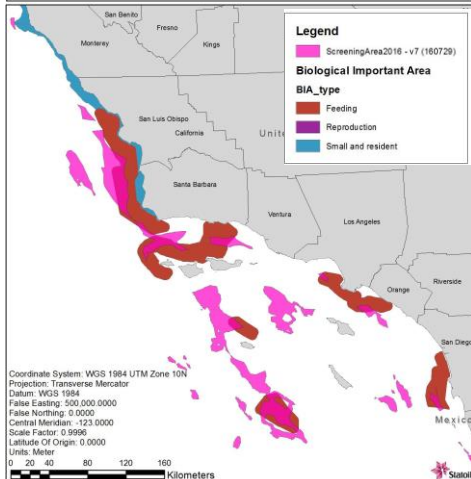
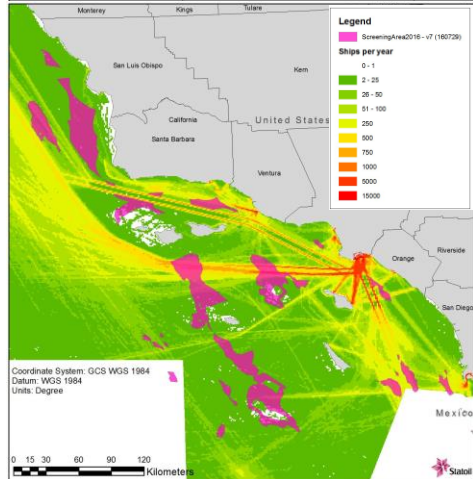
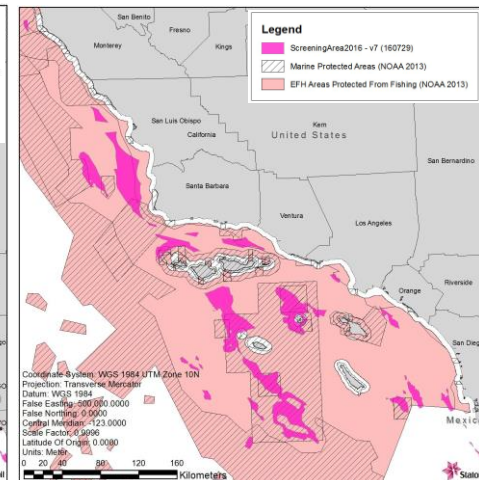
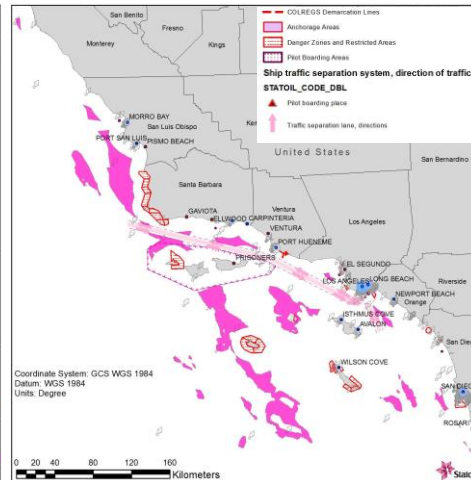
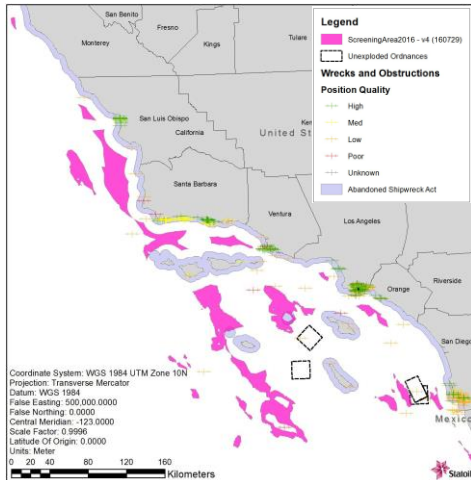
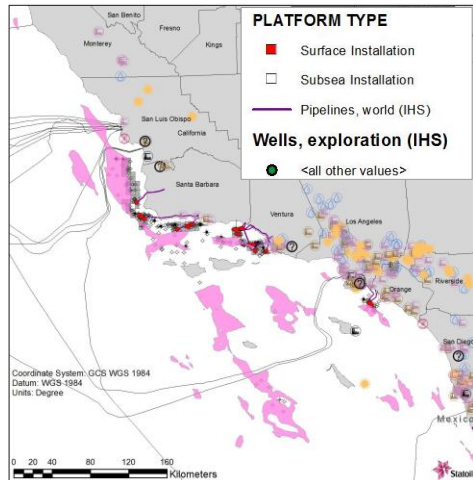
Hard constraints, technical

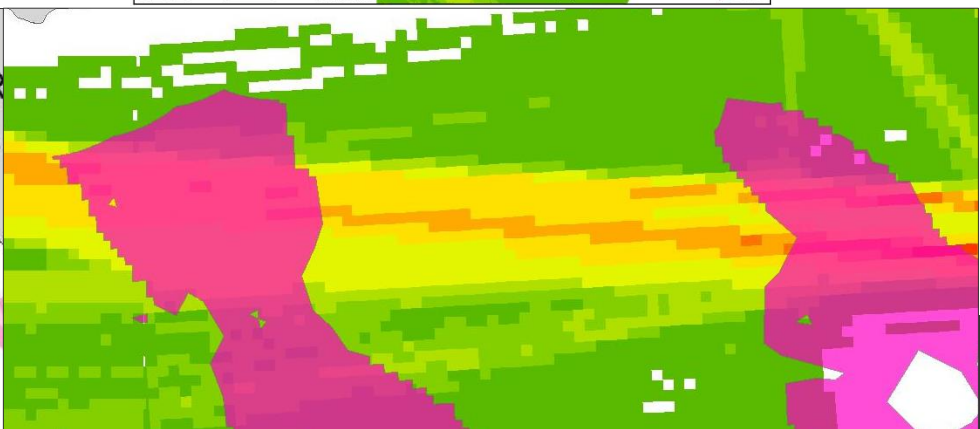
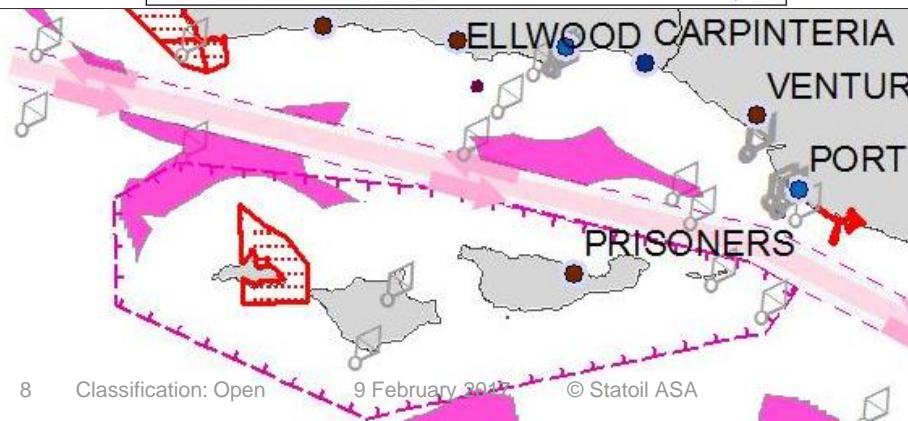
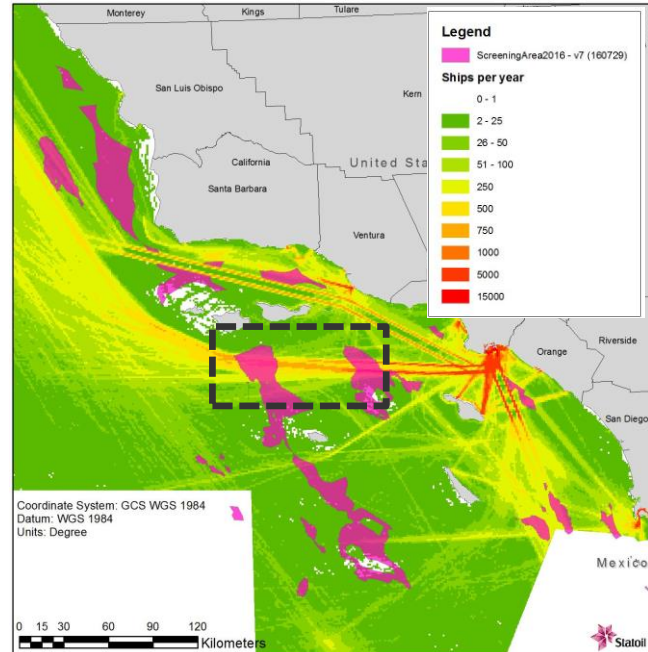
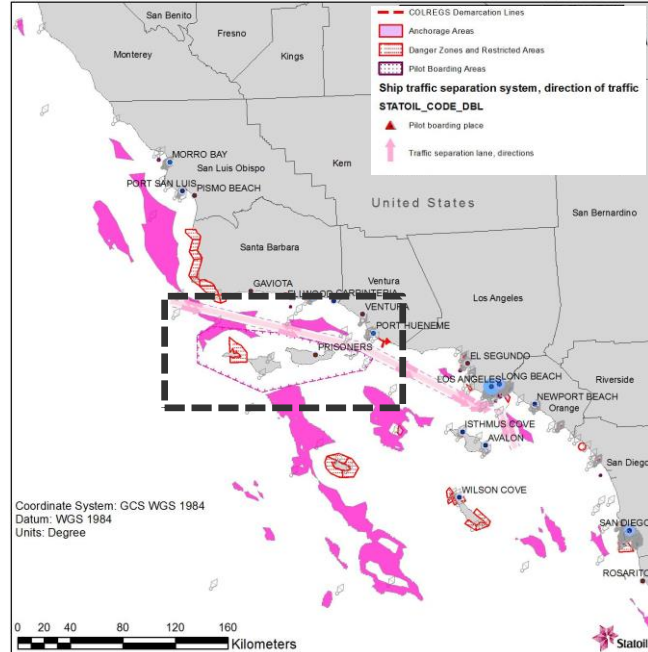
- Water depth
- Wind resource
- Distance from shore
- Geology,
- Wrecks, UXO, archaeology
- Cables, pipelines, installations



MarineCadastr data and mapping tool









Western snowy plover. Credit: Kerry Ross

Protected species



Viewshed, tourism, recreation



Military, radar



Credit: Michael Stephenson

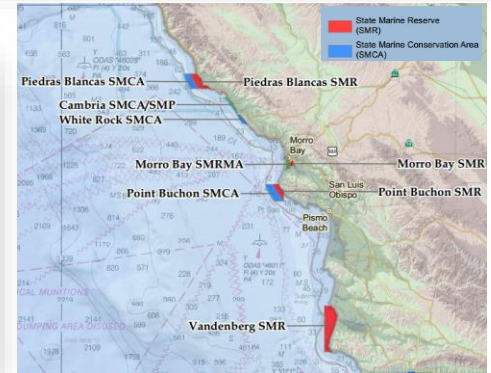
Experiences from site selection and EIAs in Europe and US



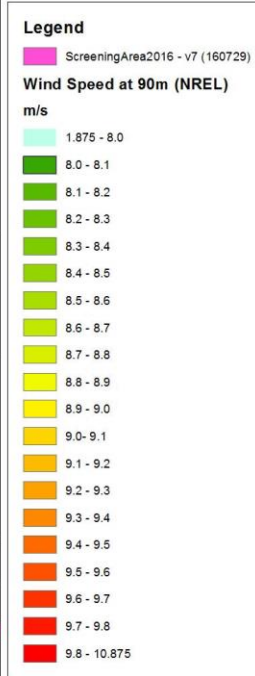
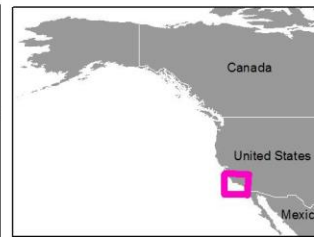
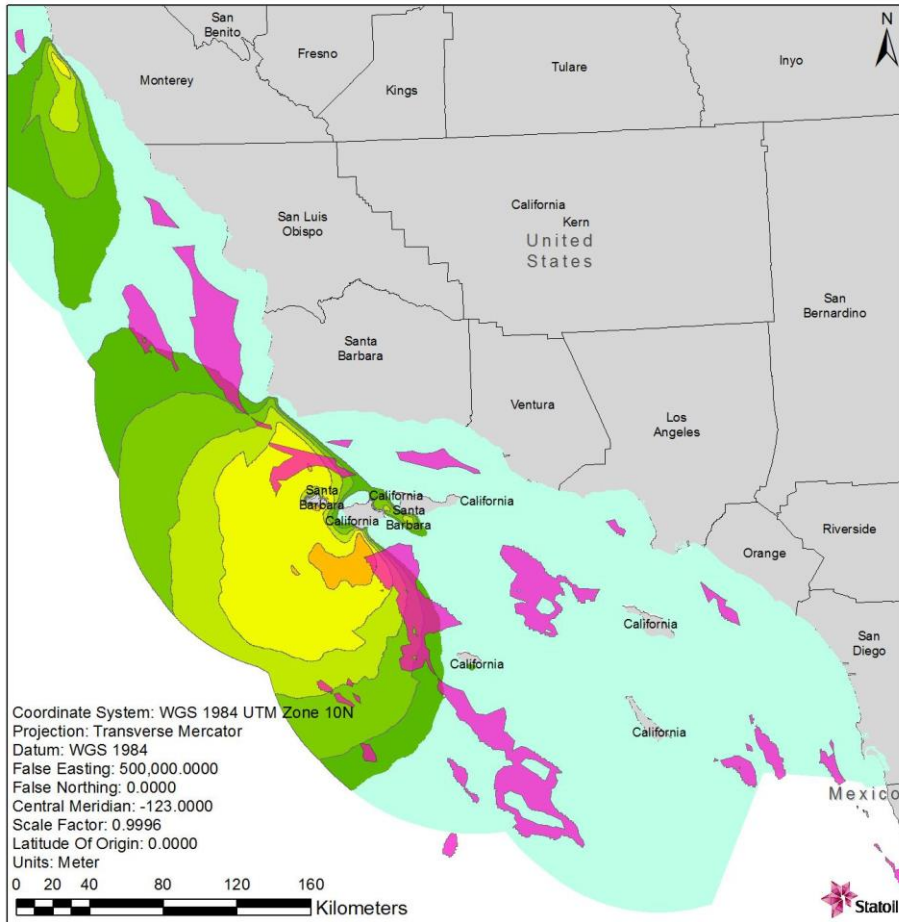
Shipping & Navigation



Civilian Aviation



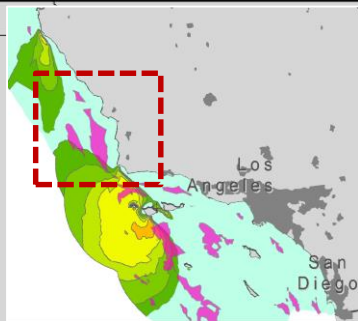
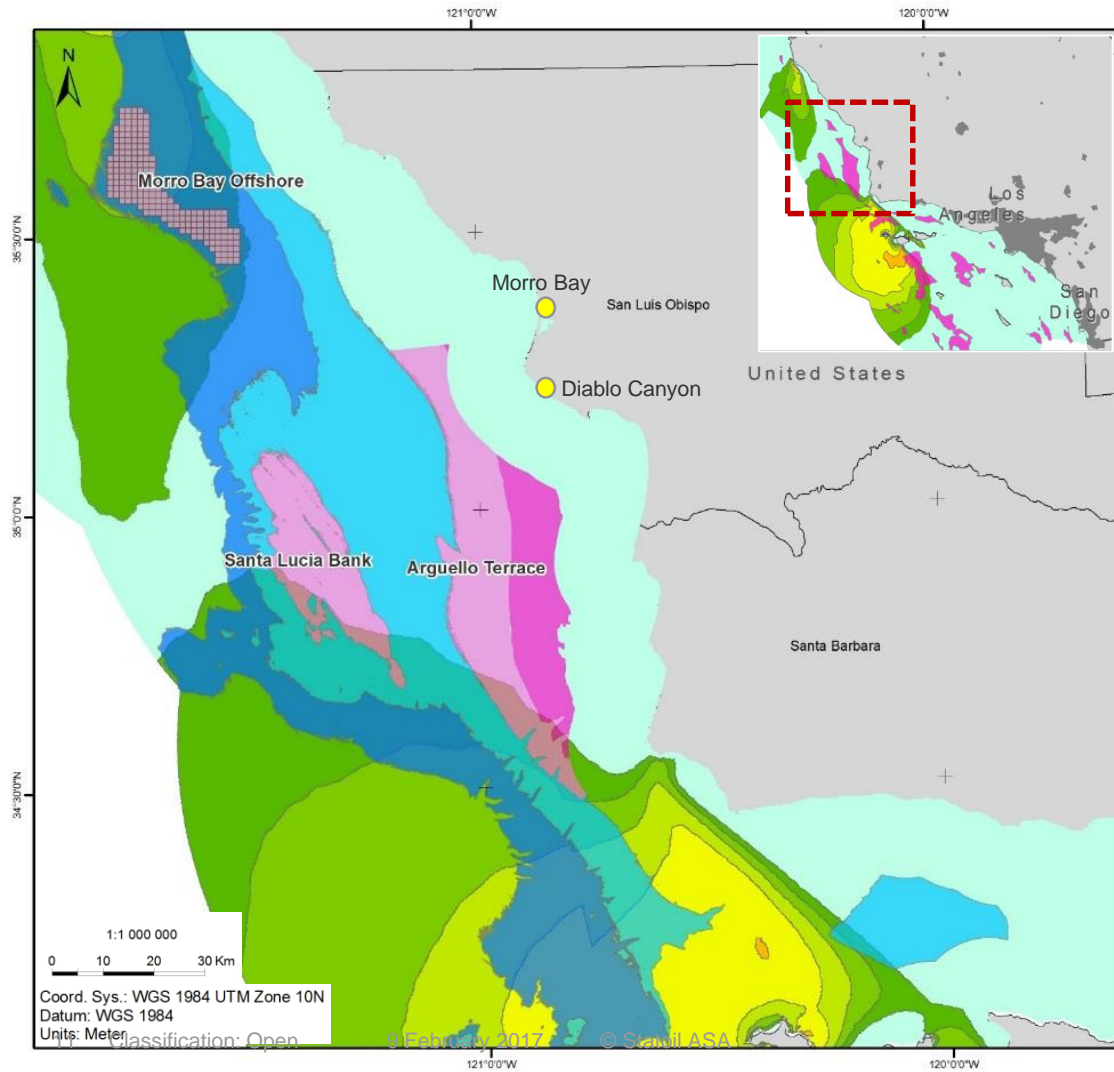
Protected areas



Technical Appraisal

Included, but not limited to:

- Wind resource (modelled)
- Export cable route:
 - Distance
 - Complexity
 - Landfall & grid connection
- Water depth:
 - Inter-array cables
 - Moorings
 - Installation complexity;
- Metocean conditions:
 - Installation
 - O&M
- Distance from landfall / grid connection:
 - O&M accessibility
 - Transmission losses
 - Transmission solutions
- Levelized Cost of Energy (LCOE)
 - Comparison of sites
 - Comparison on phased approach



Potential lease areas

Depth Value

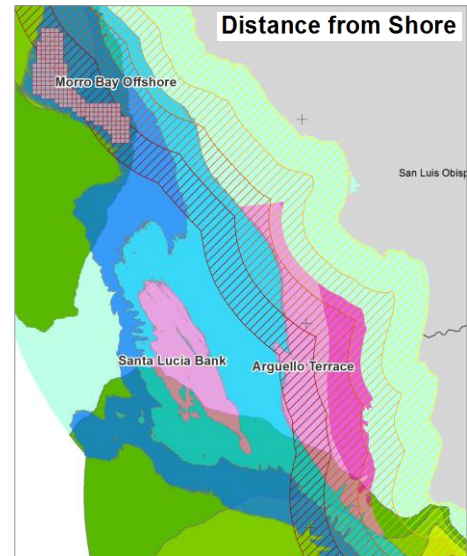
- 300 - -120
- 500 - -300
- 700 - -500
- 1000 - -700

Wind Speed at 90m (NREL)
m/s

- 1.875 - 8.0
- 8.1 - 8.2
- 8.3 - 8.4
- 8.6 - 8.7
- 8.8 - 8.9
- 9.1 - 9.2
- 9.3 - 9.4

Distance from Shore
Nautical miles

- 0 - 5
- 5 - 10
- 10 - 15
- 15 - 20



Potential grid connection

Statoil. The Power of Possible

Offshore Wind Lease Areas

California 'near-term'

Martin Goff, Development Manager

Offshore Wind

Statoil

www.statoil.com

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