

# CalWind: Evaluating Offshore Wind Energy Feasibility off the California Central Coast



September 17, 2015



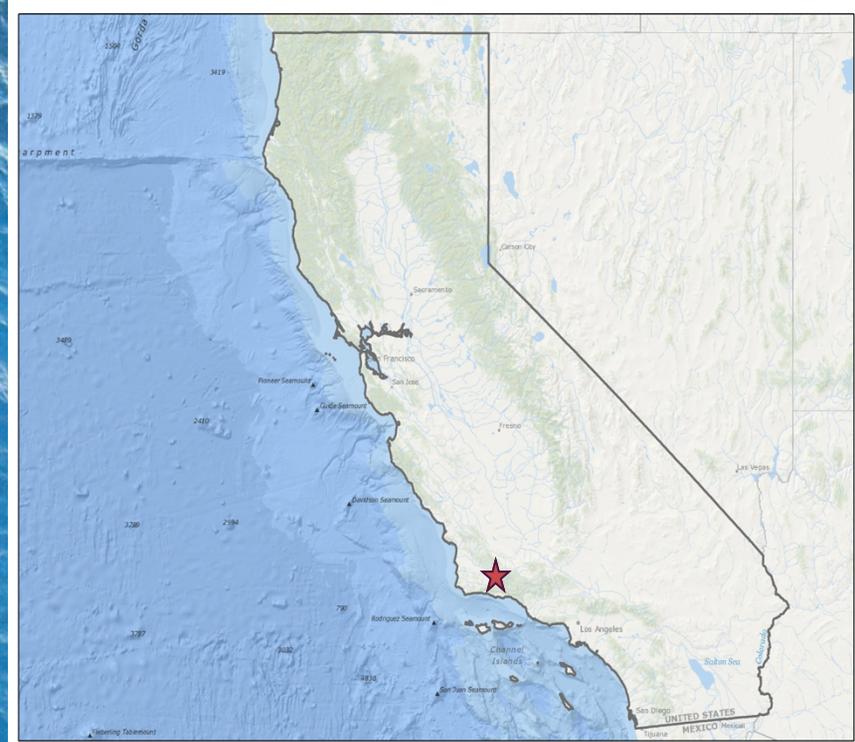
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Dr. Bruce Kendall



# Why Offshore Wind?

## California Demand

- California Renewable Portfolio Standard
  - 33% by 2020
  - 22.7% in 2013
- Political pressure for more



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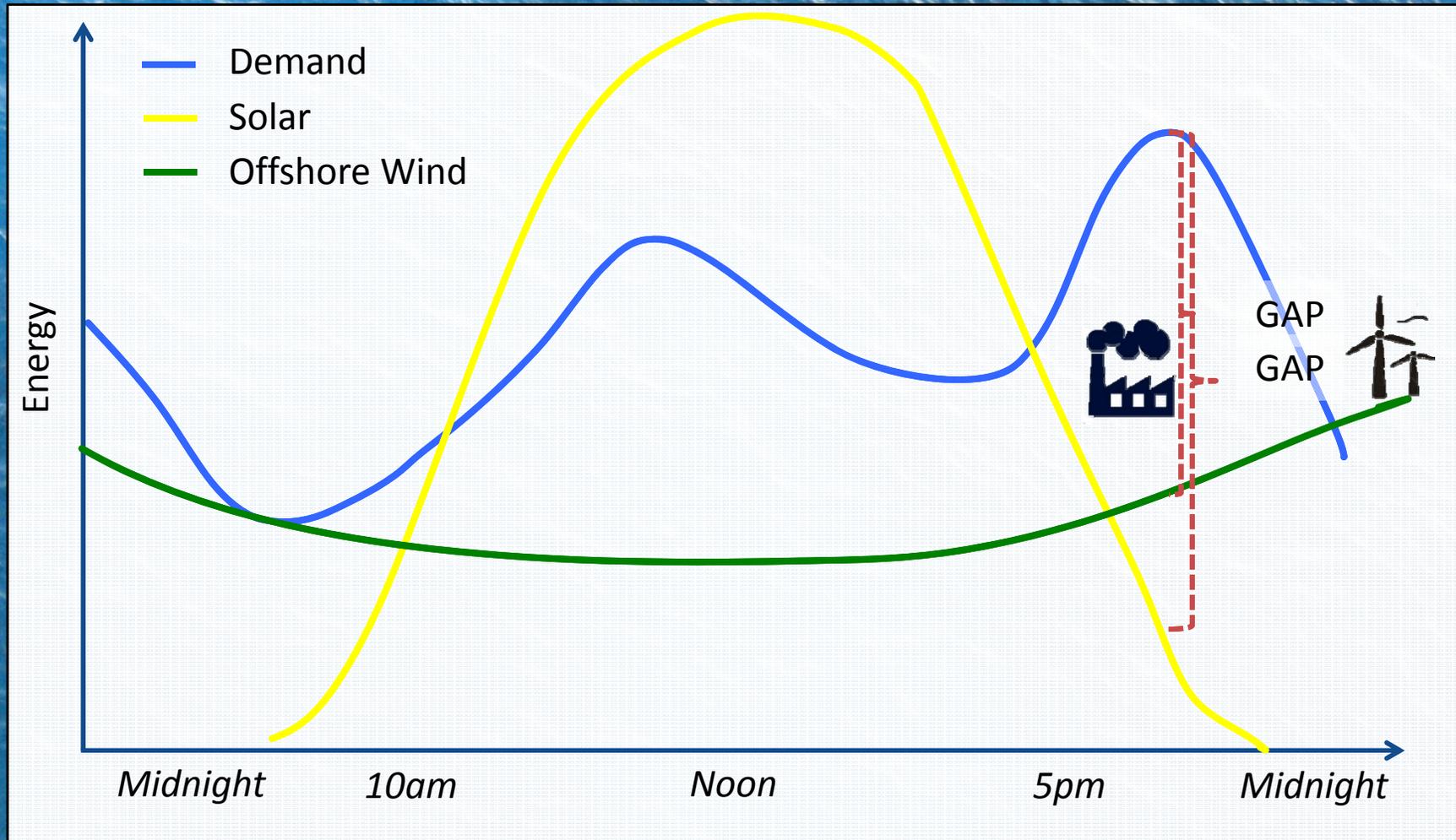
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# Solar and Wind as Complements



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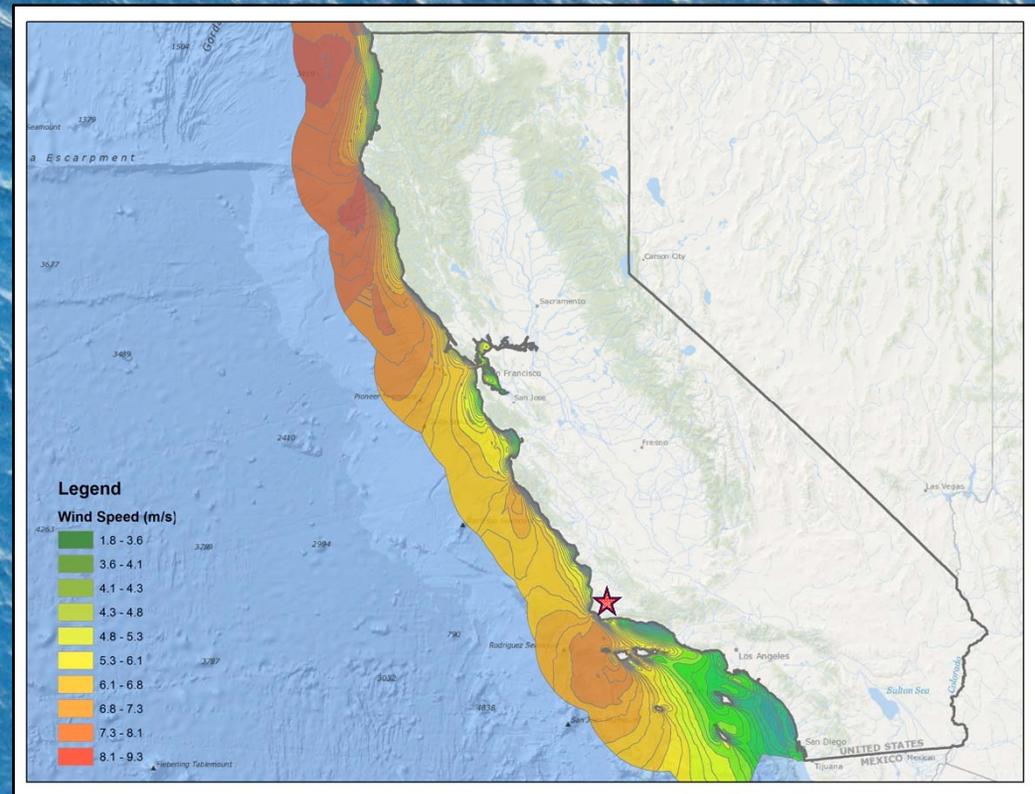
# Offshore Wind Resource & Benefits

## High Energy Potential

- CA Offshore Wind  
*~655 GW of power*
- 2x California current  
electrical demand.
- Net energy exporter

Energy Reliability

New jobs



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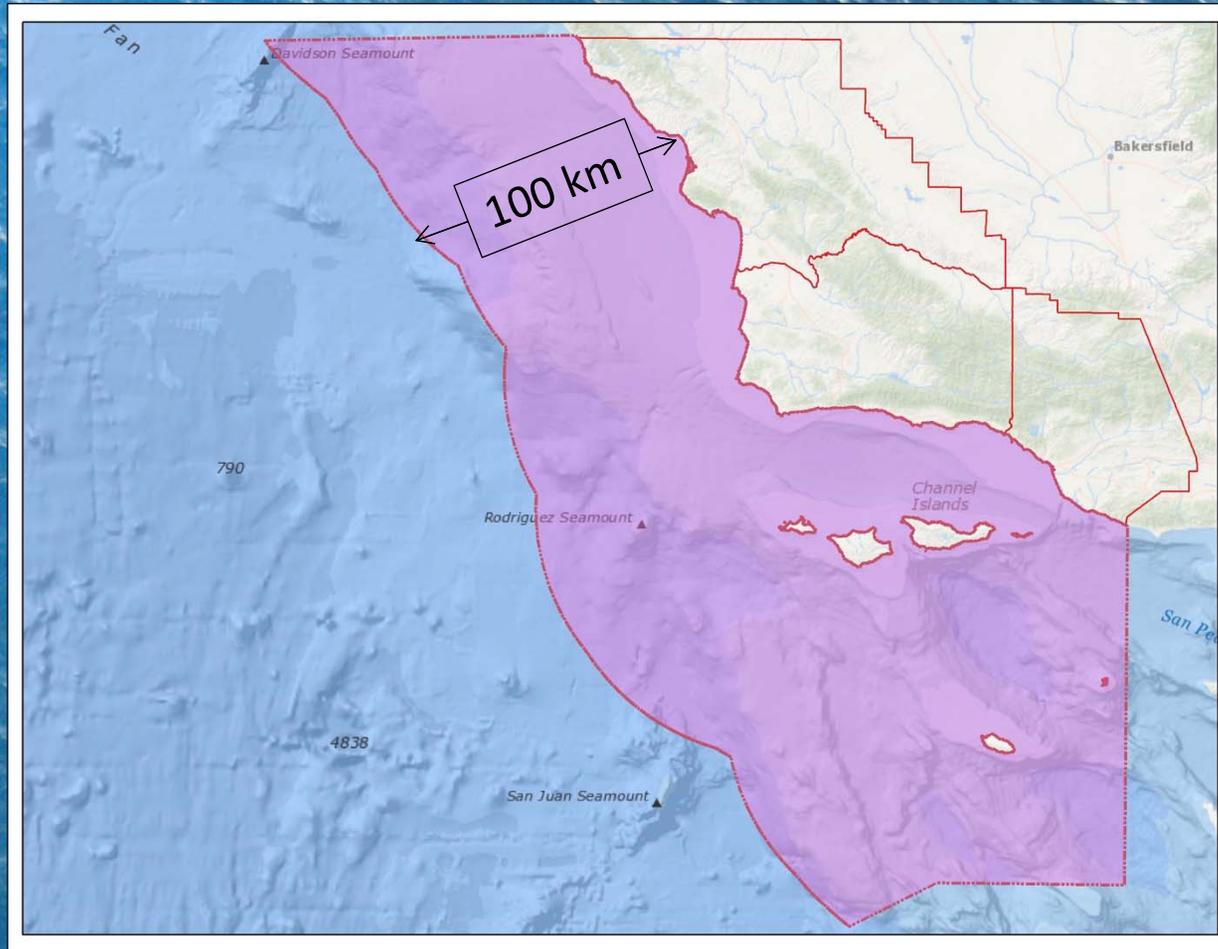
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# Region of Interest



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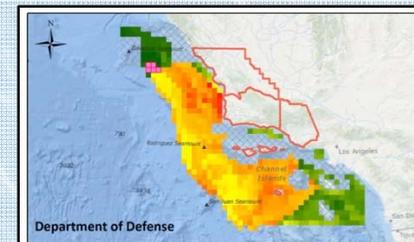
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# Research Question

*What is the feasibility of offshore wind energy development in Central California?*

1. Identify & Analyze the Permitting Pathway
2. Stakeholder Analysis
3. Spatial Analysis of Region of Interest (ROI)



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# Permitting Pathway



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# Permitting Analysis: Objectives & Assumptions

## Objectives:

1. What happens when?
2. Who needs to talk to whom?
3. Who is in charge?
4. Communicate to Stakeholders

## Assumptions:

1. Federal waters
2. Floating platforms
3. 200 MW

# Permitting Analysis: Sources & Methods

## Sources:

*Existing federal, state, and local statutes, including:*

- NEPA, CEQA
- Clean Water Act, Clean Air Act
- Federal & State Endangered Species Acts
- Federal Aviation Act
- Coastal Zone Management Act
- MMPA & Sustainable Fisheries Act
- California Coastal Act

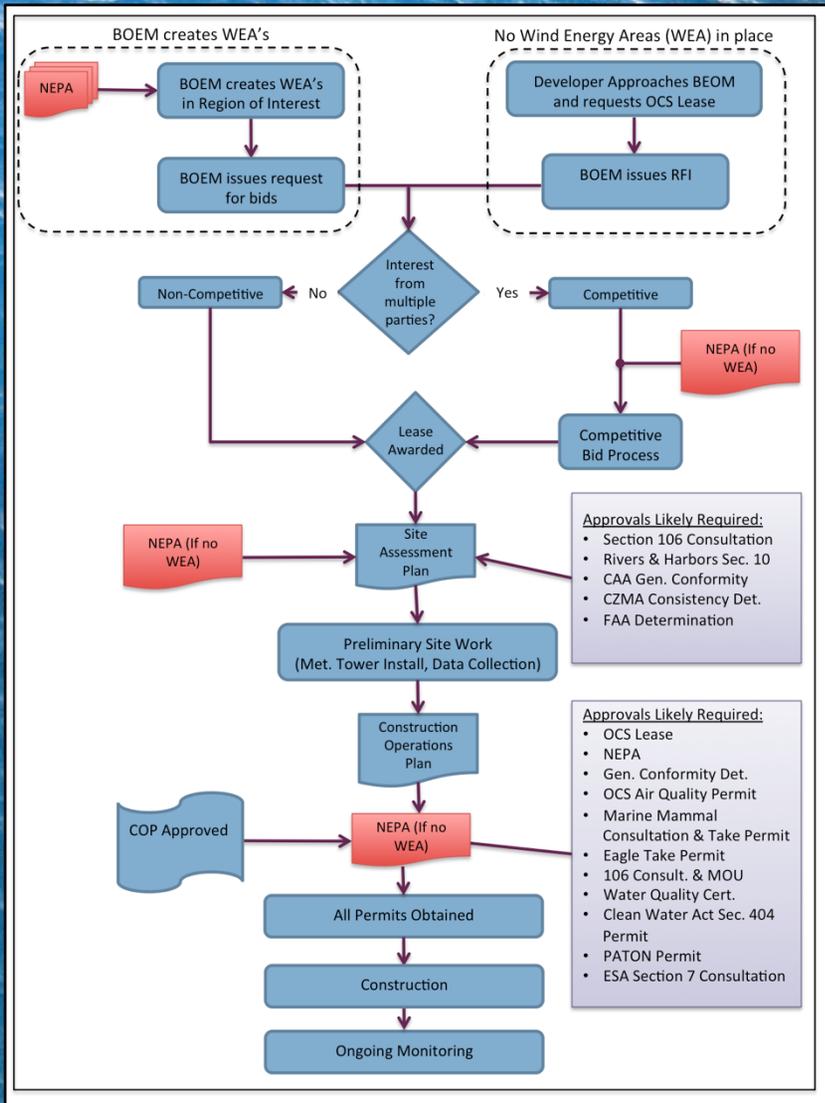
*Interviews with key permitting stakeholders, including:*

- BOEM, USFWS,
- County of SB Energy Department

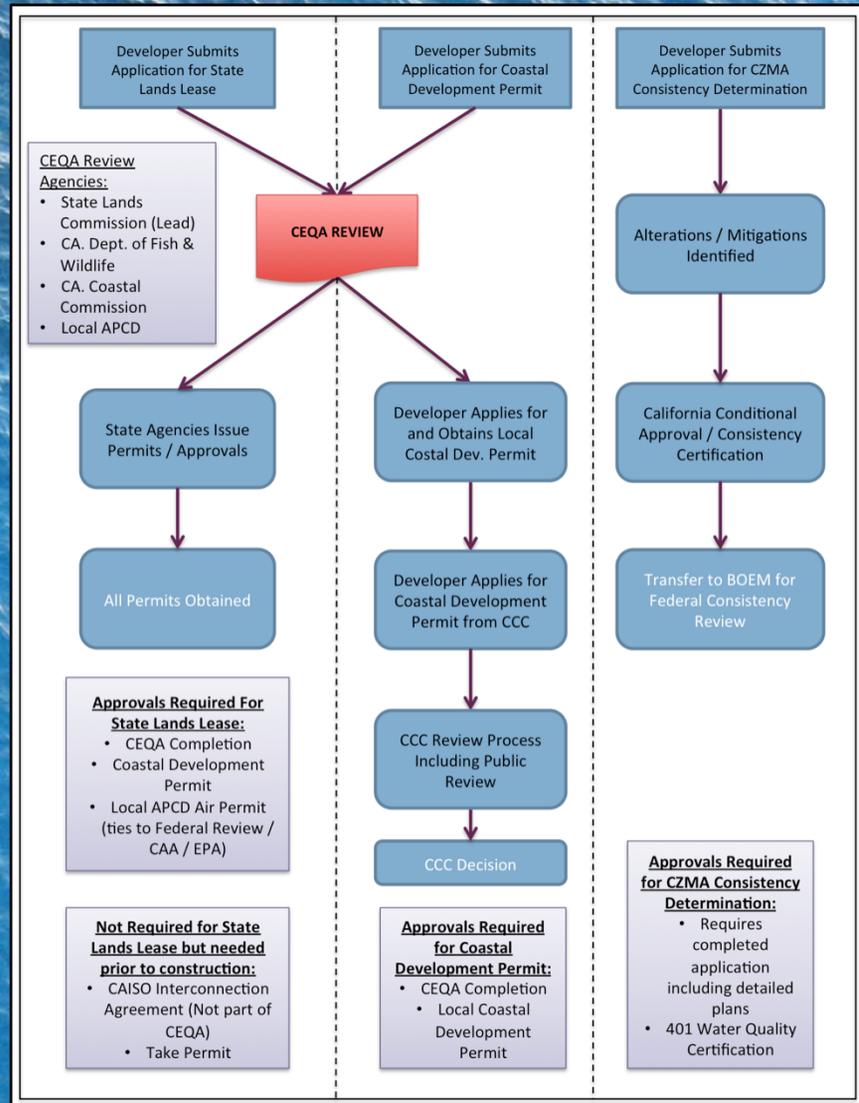
## Methods:

- **Identify regulations**
- **Identify agencies** responsible for the implementation of these regulations.
- **Define process** of implementation and enforcement (permit, consultation, certificate, etc.).
- **Identify externalities** / unintended consequences of process

# Federal Permitting Flowchart



# State Permitting Flowchart



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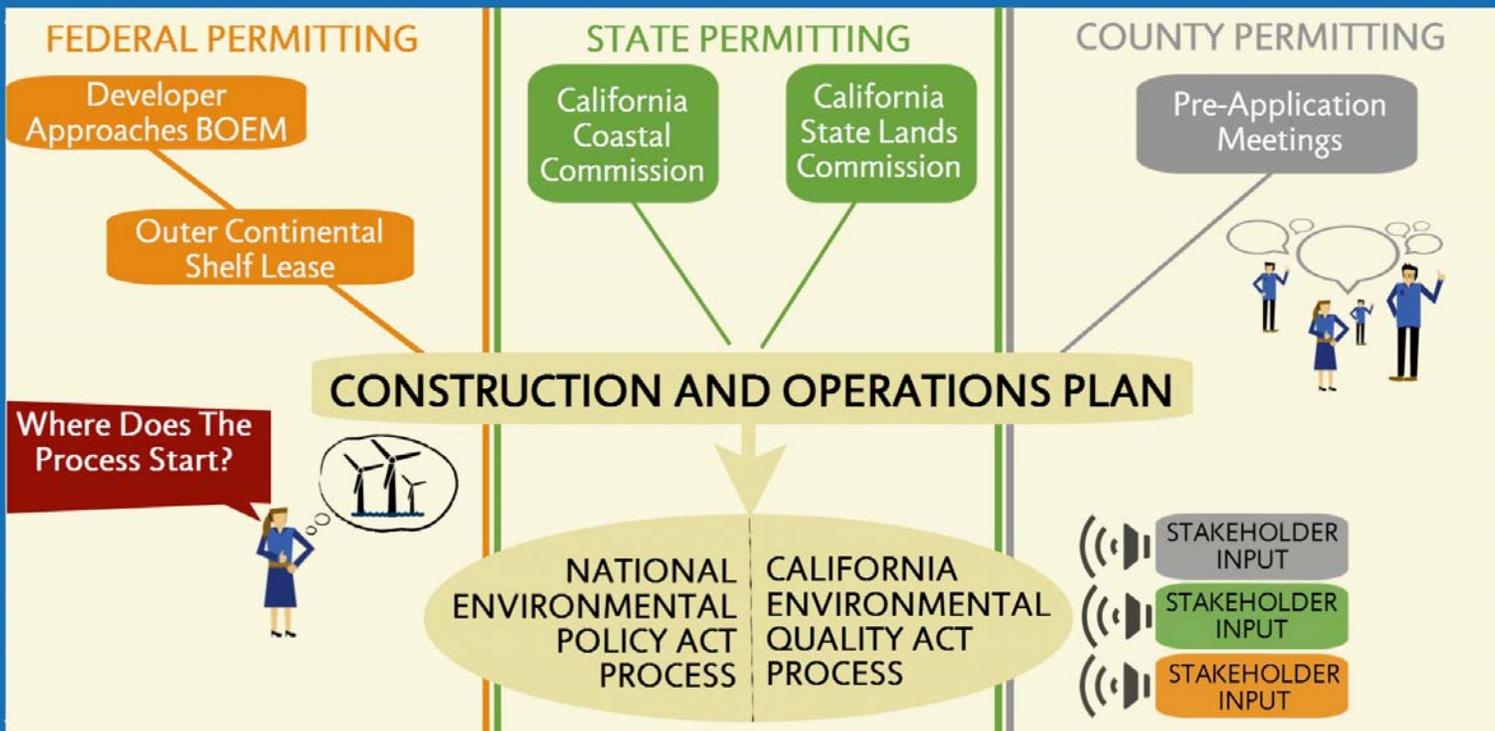
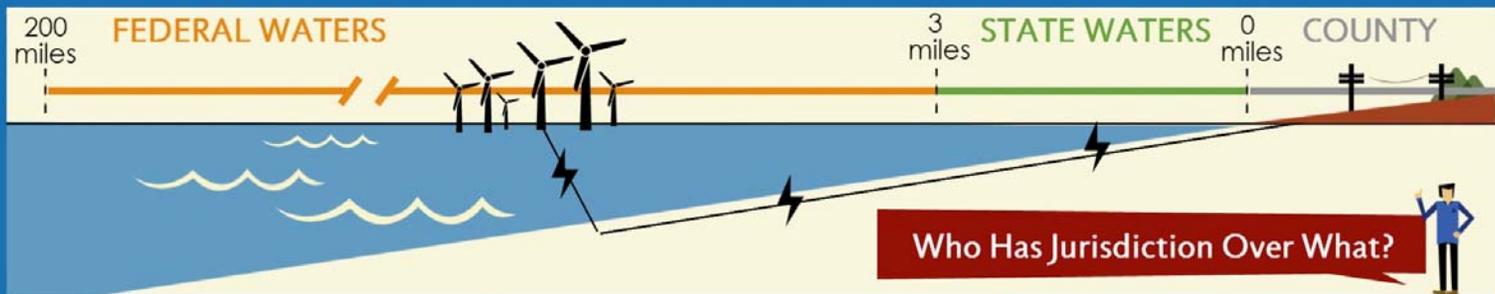
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# NAVIGATING THE PERMITTING PATH TO OFFSHORE WIND ENERGY IN CALIFORNIA





**17**

POSSIBLE  
FEDERAL  
APPROVALS

**8**

POSSIBLE  
STATE  
APPROVALS

**3**

POSSIBLE  
COUNTY  
APPROVALS

### Who Is Overrepresented?

**4** Laws cover avian species



**3** Laws cover marine mammals



### Who Is Underrepresented?



Commercial Fisherman

Native Americans  
*Chumash*



Minority Groups

### What Happens When?



# Permitting: Analysis of Results

- Up to 28 approvals
- East Coast activities have set a precedent for Federal permitting
- Need for a BOEM Task Force
  - Wind Energy Areas
  - Strengthen Federal and State coordination
  - Ease developer burden
- Disproportionate representation



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# Stakeholder Analysis



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# Stakeholder Analysis



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# Stakeholder Analysis: Objectives

## SNAPSHOT

### 1. Public Survey

- Public knowledge of energy issues
- Attitudes and concerns
- Willingness to pay
- Analyze the factors influencing attitude

### 2. Key Stakeholder Interviews

- Underrepresented stakeholders
- Expert input

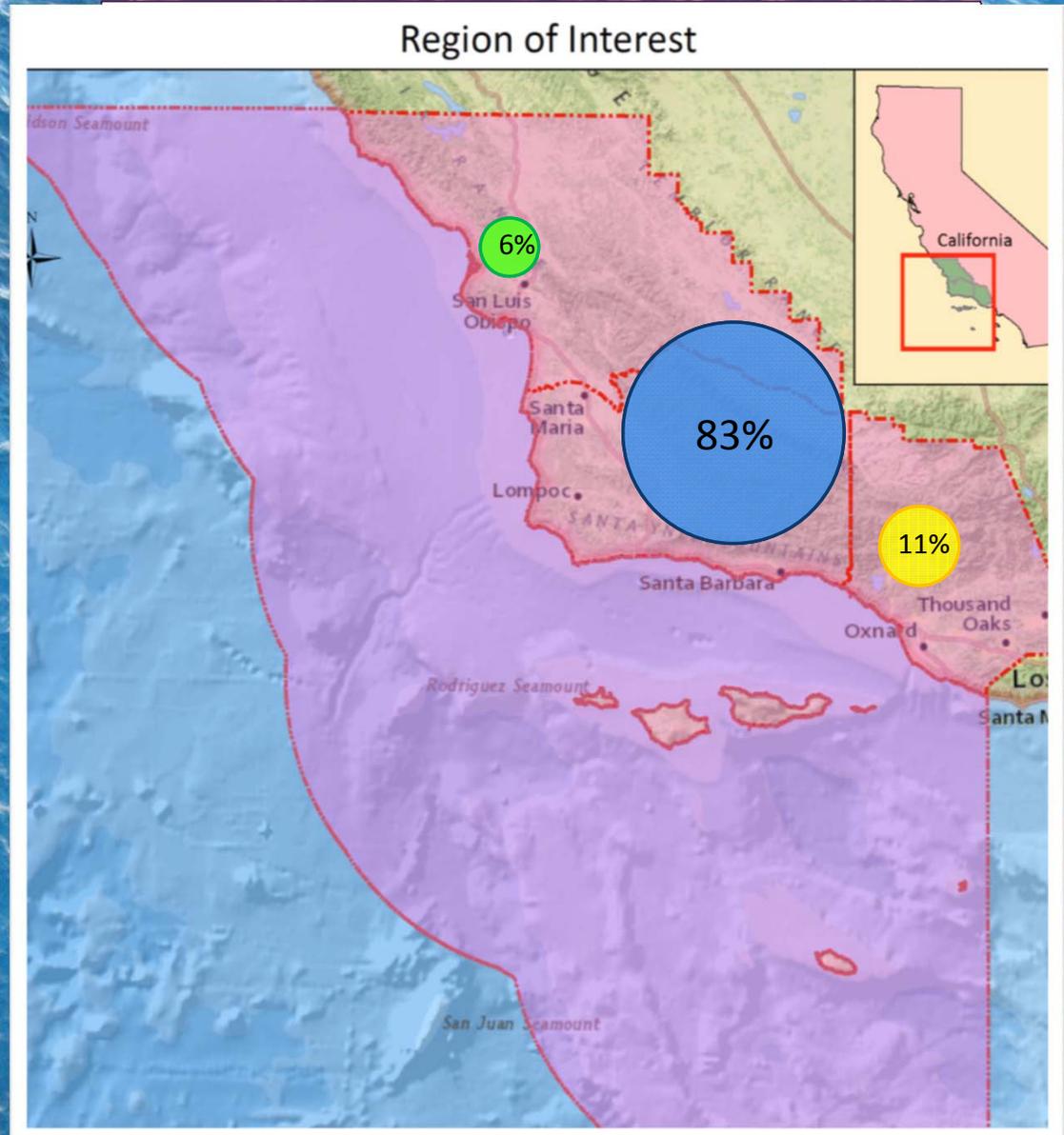
## Stakeholder Analysis: Data Sources

### 1. Public Survey (Survey Monkey)

- 24 Questions
- *Santa Barbara Independent*
- Representativeness
- 475 Respondents, 351 in ROI

### 2. Key Stakeholder Interviews

- In-person interviews
- Channel Islands National Marine Sanctuary Advisory Council (SAC)



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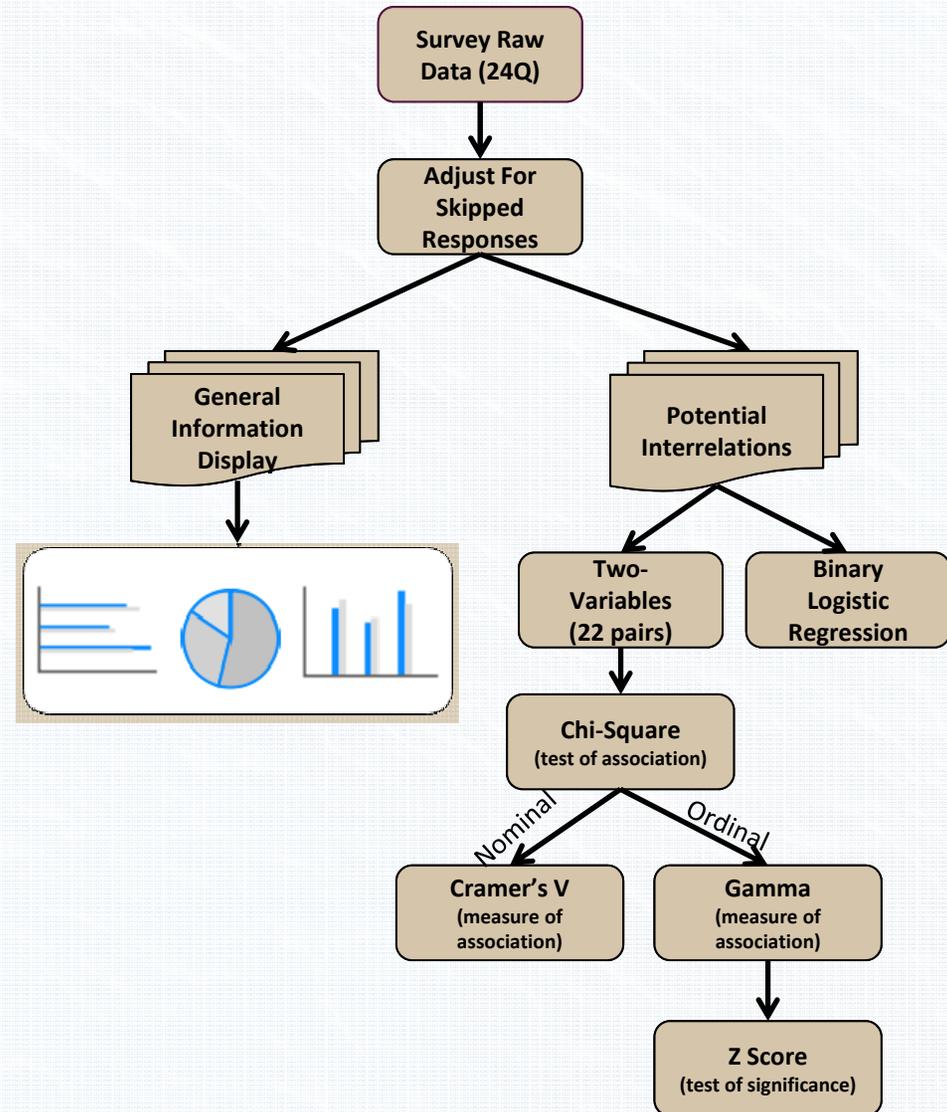
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## Stakeholder Analysis: Methodology

- What's the response distribution for each question?
- Is there a correlation between two responses?
- How strong is the correlation?
- What's the trend?
- What are the factors influencing people's support or opposition?



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# Stakeholder Analysis: Results: What do people care about?

## Energy Issue



**29%**

RENEWABLE  
ENERGY



**18%**

FOSSIL FUEL  
RELIANCE



**17%**

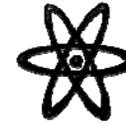
GREENHOUSE GAS  
EMISSIONS

## Least Preferred



**57%**

COAL



**27%**

NUCLEAR



**7%**

OIL

## Energy Concern



**60%**

ENVIRONMENTAL  
IMPACT



**16%**

RELIABILITY



**11%**

LOW  
COST

## Potential Renewable



**65%**

SOLAR



**20%**

WIND



**4%**

WAVE

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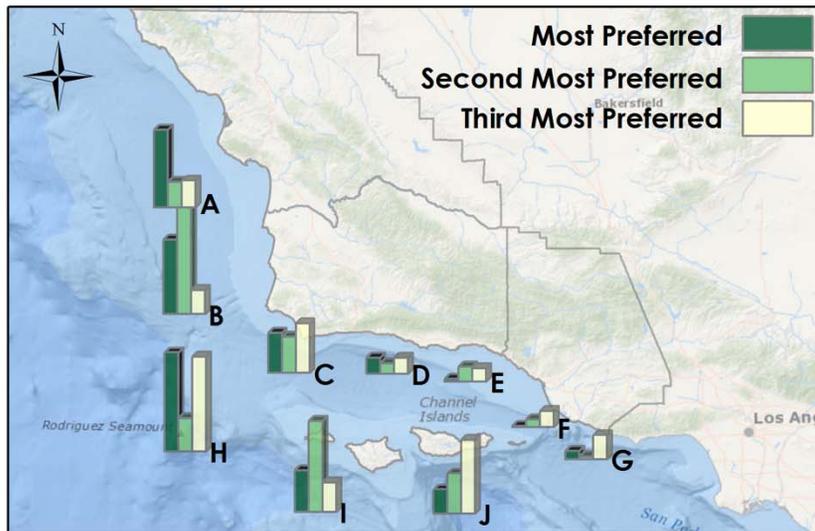
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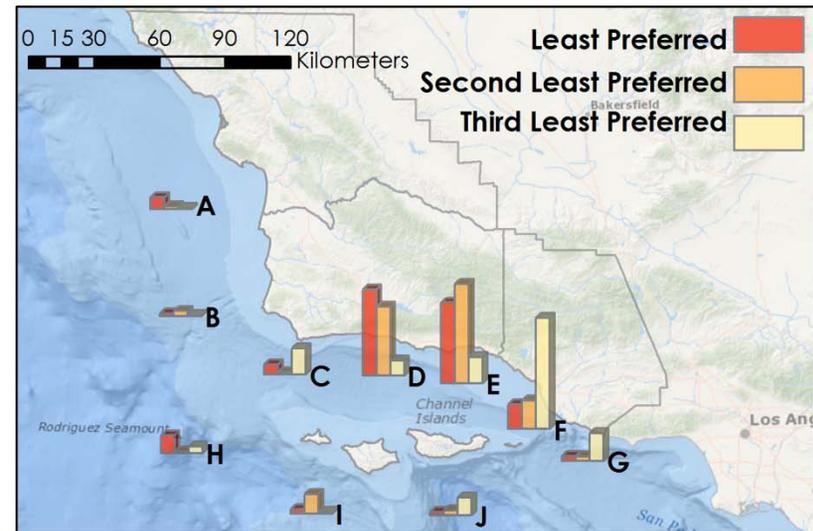
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# Stakeholder Analysis: Results: Where do people prefer?



**Most Preferred Offshore Wind Locations**



**Least Preferred Offshore Wind Locations**

Service Layer Credits: Sources: Esri, GEBCO, NOAA, National Geographic, DeLorme, HERE, Geonames.org, and other contributors

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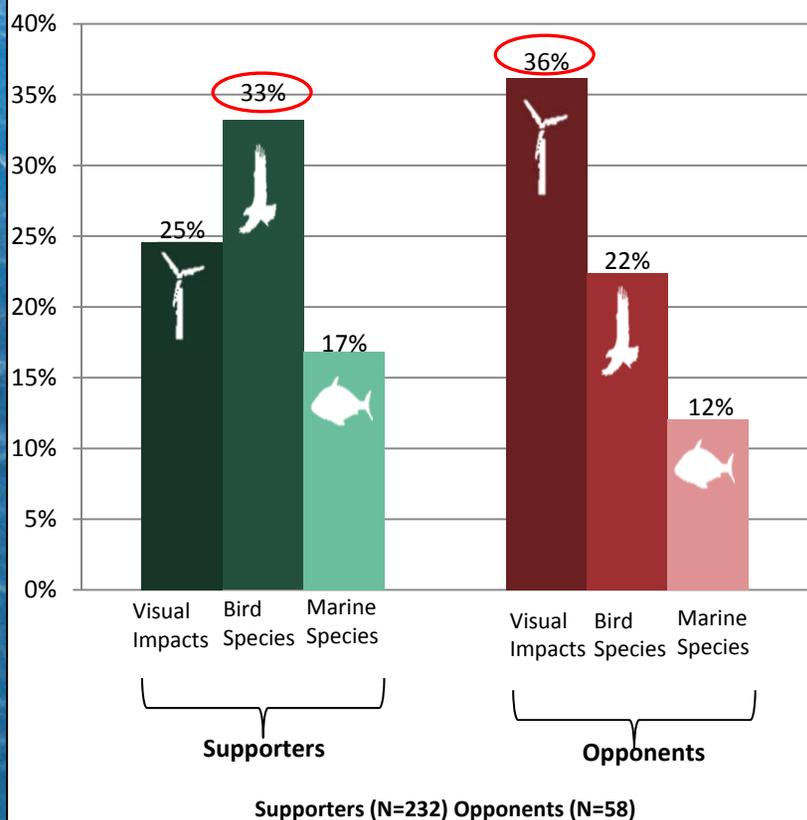
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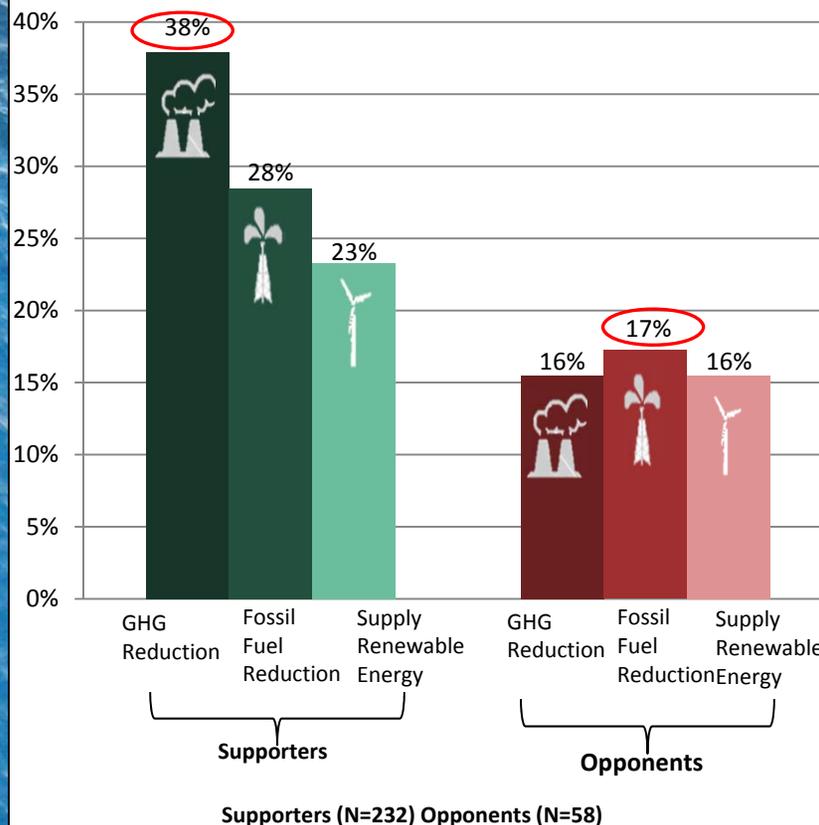
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# Stakeholder Analysis: Results: What are the impacts?

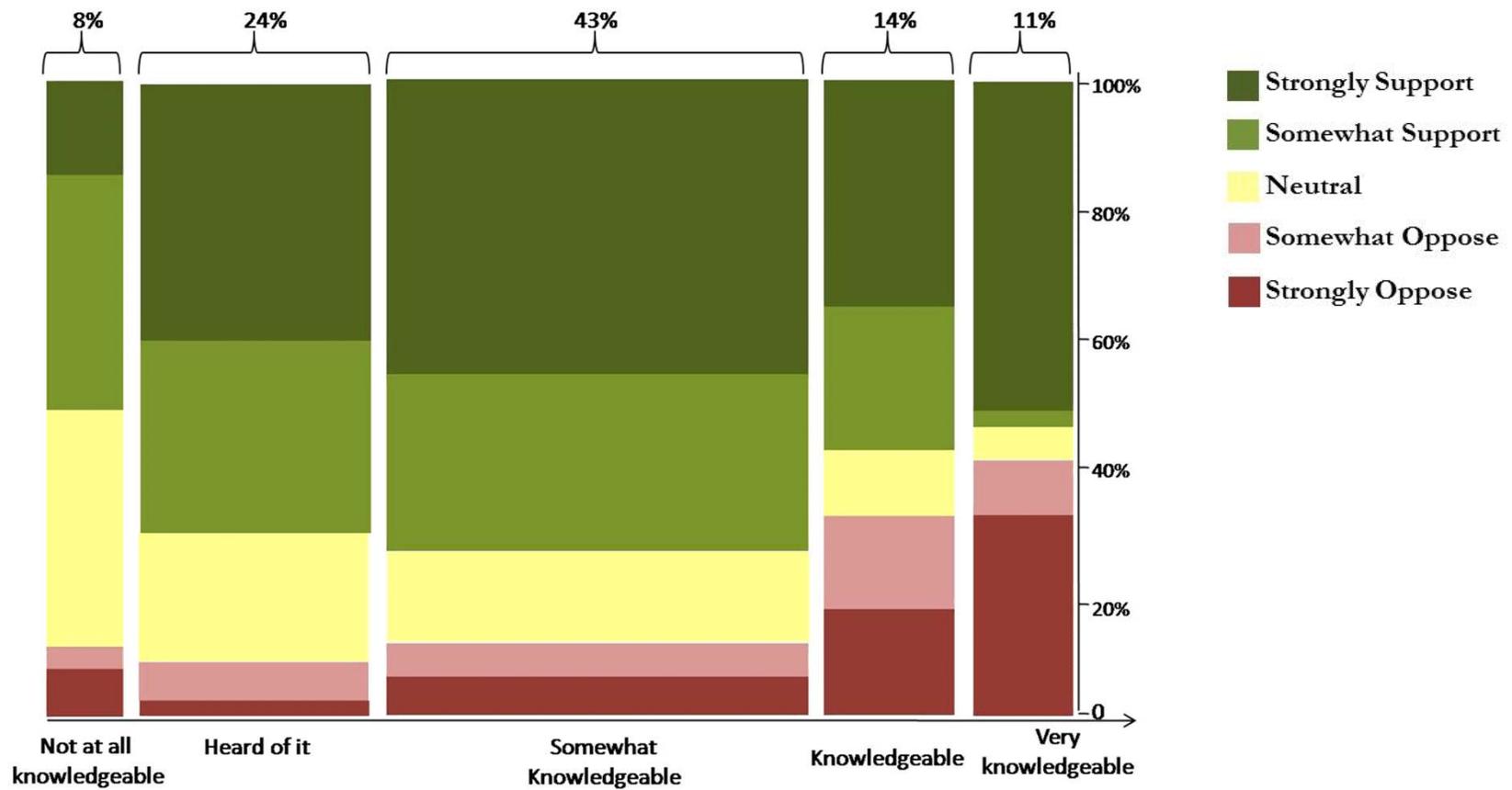
### Top Three Most **Negative** Impacts



### Top Three Most **Positive** Impacts



# Stakeholder Analysis: Result: Knowledge Level vs. Attitude



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# Stakeholder Analysis: Logistic Regression Results

Factor Influencing Support	Effect
Location of Residence	Santa Barbara County residents are more likely to support
Sex of Respondents	Females more supportive than males
Respondents level of knowledge of OSW	Intermediate level of knowledge of OSW more supportive
Respondents' working industry	Works in environmental or energy industry more supportive

Based on logistic regression of respondents indicating "support" v.s. "oppose" (n=226). All variables were significant with  $P < 0.05$

## Stakeholder Analysis: Conclusions

- Attitude: A majority of respondents support offshore wind energy
- Concern: Perceived impact on birds, marine mammals, and viewsheds
- Location: Preferred areas are far from the coastline
- Future: Need more representative data for comprehensive analysis



# Spatial Analysis

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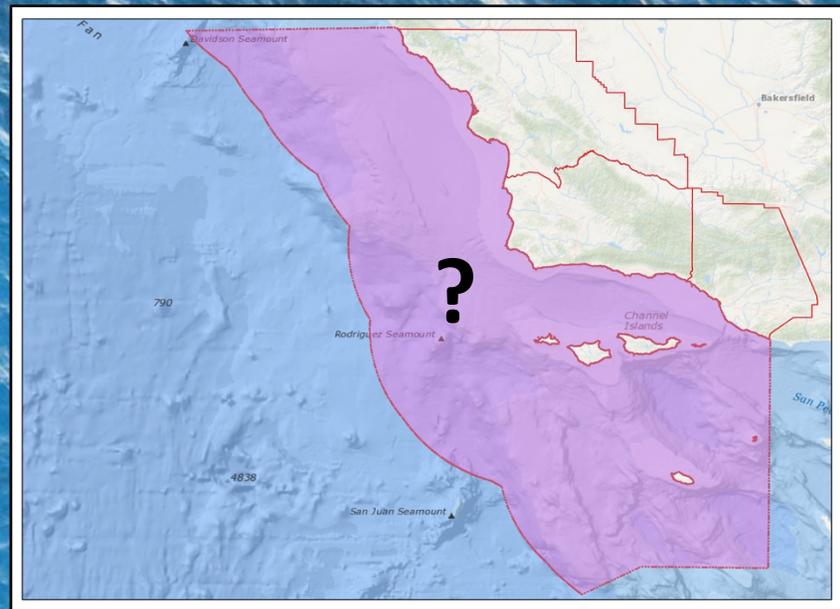
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# Spatial Analysis: Objectives

1. Framework for offshore wind spatial planning
  - Multi-Criteria Decision Analysis (MCDA)
2. Highlight locations with development potential

## Outside of Scope:

Recommending specific development locations



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# Spatial Analysis: Assumptions

1. Wind farm size:
  - 200 MW farm
  - 33-6MW turbines
  - 100 km<sup>2</sup> spatial array
2. Exclusion areas:
  - Shipping Lanes
  - National Marine Sanctuary Boundaries
3. Floating wind turbines

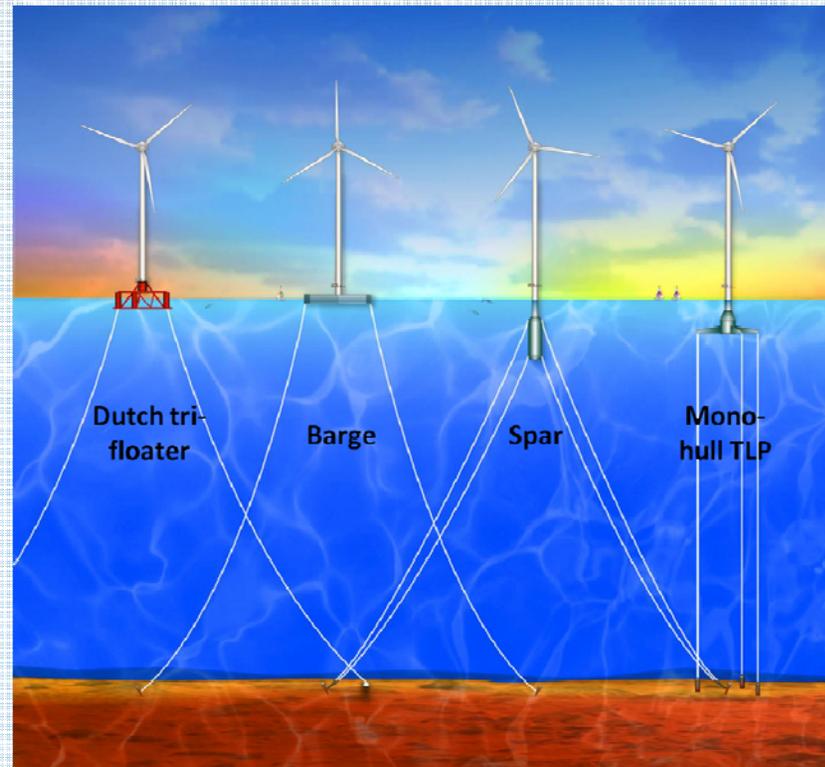
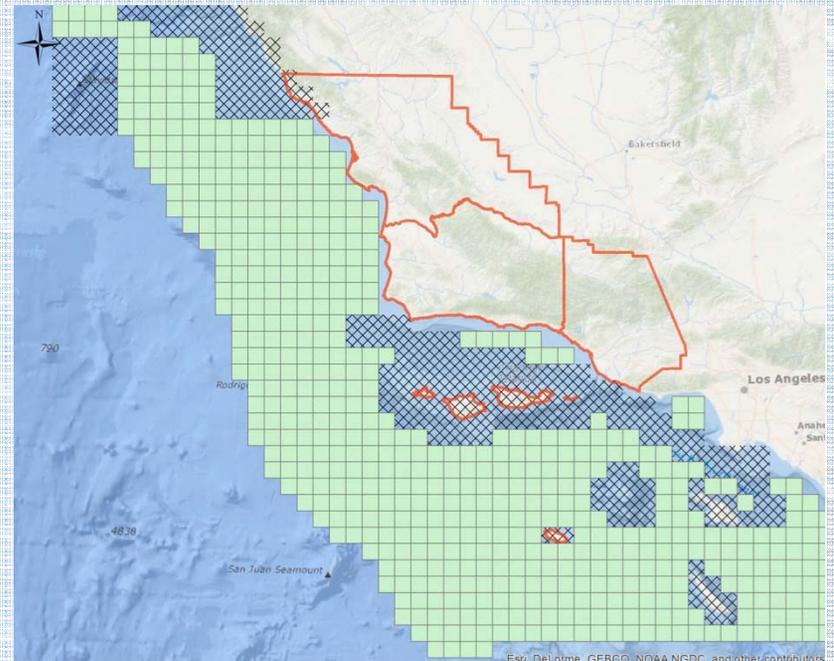


Photo credit: UCSD

# Spatial Analysis: Basic Approach to MCDA

1. Converted ROI into a grid of developable cells
2. Selected seven variables
3. Determined value of each variable for every cell
4. Weighted the importance of variables to create development scenarios



# Spatial Analysis: Data

Variable	Value is a Function of...
Wind and Electrical Infrastructure	Wind speed and distance to nearest interconnection point
Benthic Substrate	Area of hard bottom
Department of Defense Sea Range	Inside or outside range
Salmon Fishing Grounds	Grounds Fisherman defined as critical
Dragging Grounds	Grounds Fisherman defined as critical (Rockfish, Halibut, Sole, Sablefish, Crustaceans)
Bird Biodiversity	Observed species richness and distribution
Marine Mammal Presence	Observed density

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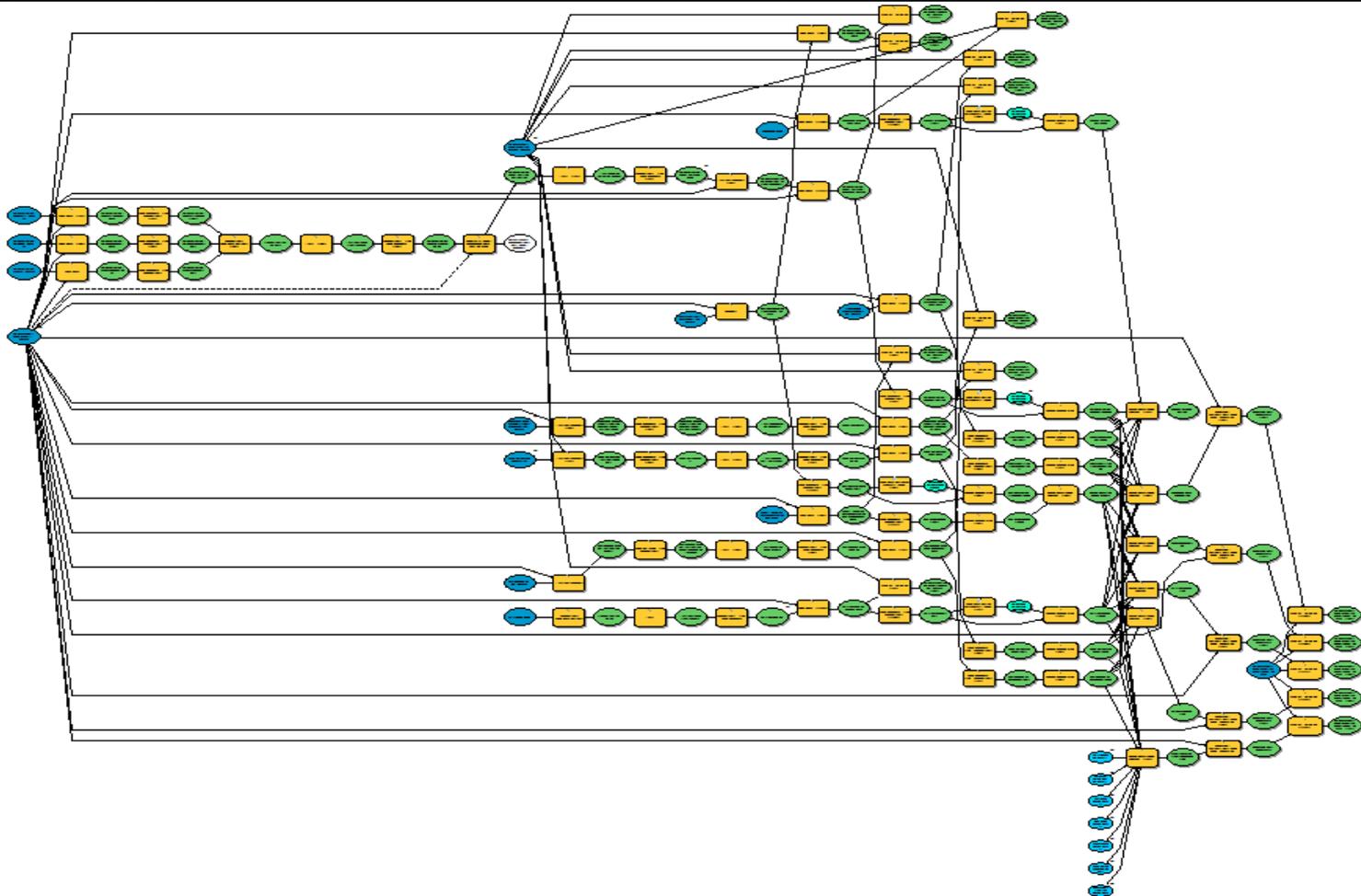
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# Spatial Analysis MCDA Model



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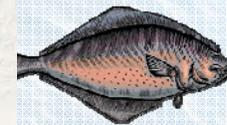
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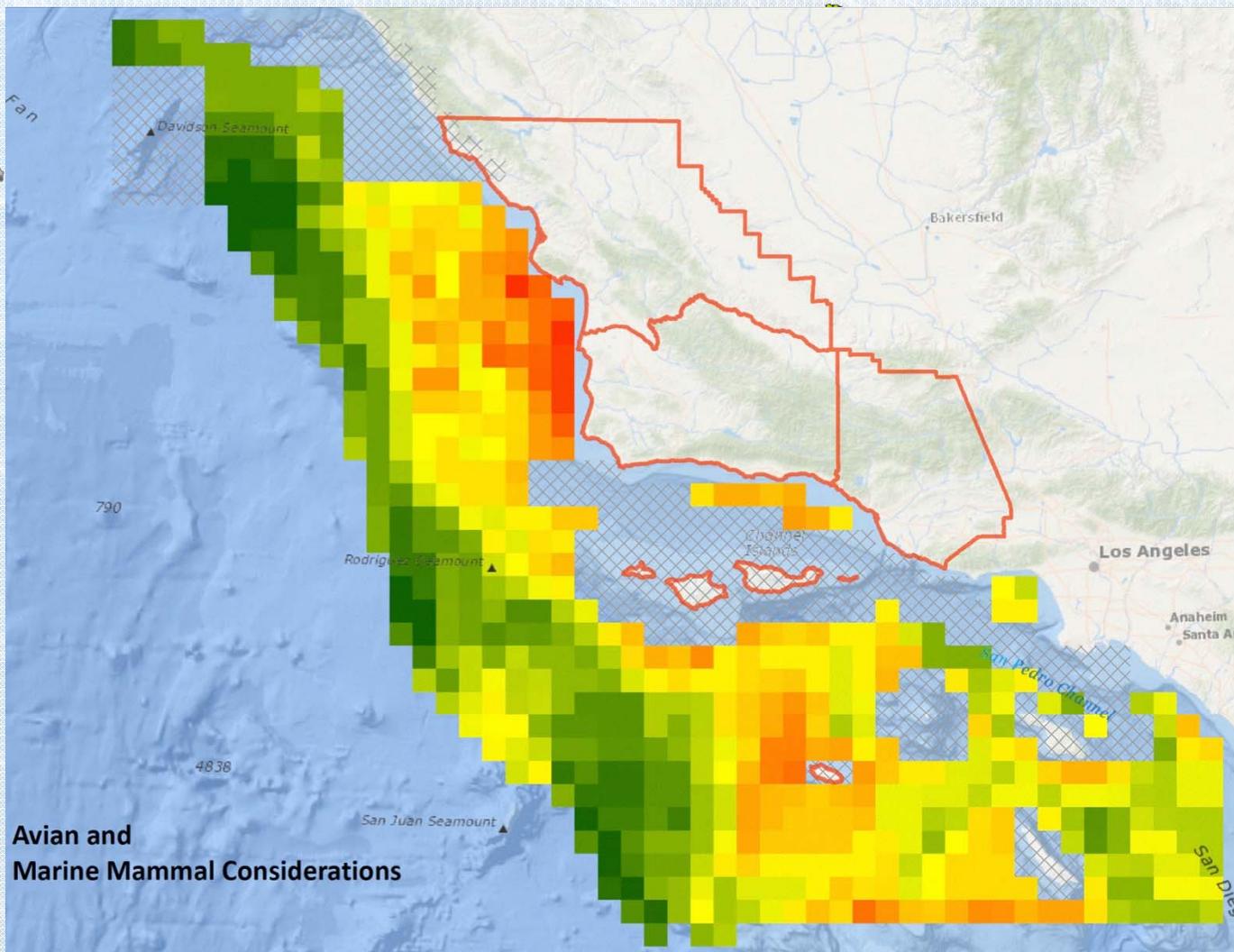
# MCDA Analysis Scenario with 7 Criteria: Bird Biodiversity, Statewide Mammal Presence



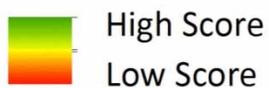
DoD  
Sea Range  
(10%)



Dragging  
Grounds  
(10%)



Avian and  
Marine Mammal Considerations



Exclusion Areas

Service Layer Credits: Esri, DeLorme, GEBCO, NOAA NGDC, and other contributors



# Spatial Analysis: Weights

Scenario	Substrate Weight	Dragging Weight	Salmon Weight	DoD Weight	Bird Weight	Mammal Weight	Wind Weight
1: DoD	10%	10%	10%	<u>40%</u>	10%	10%	10%
2: Developer	10%	10%	10%	10%	10%	10%	<u>40%</u>
3: Fishermen	10%	<u>30%</u>	<u>20%</u>	10%	10%	10%	10%
4: Bird & Mammal	10%	10%	10%	10%	<u>25%</u>	<u>25%</u>	10%

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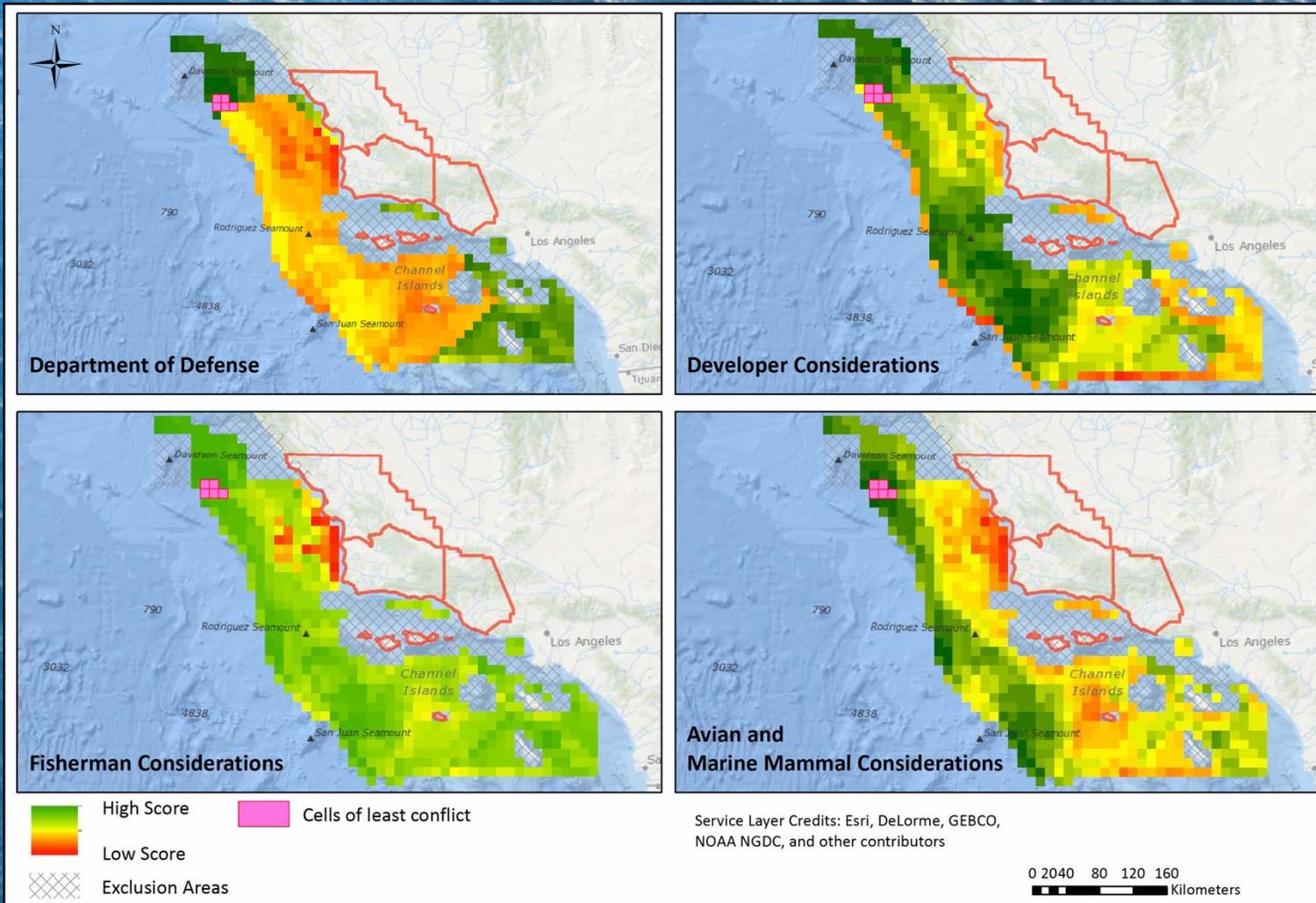
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# Spatial Analysis: Results



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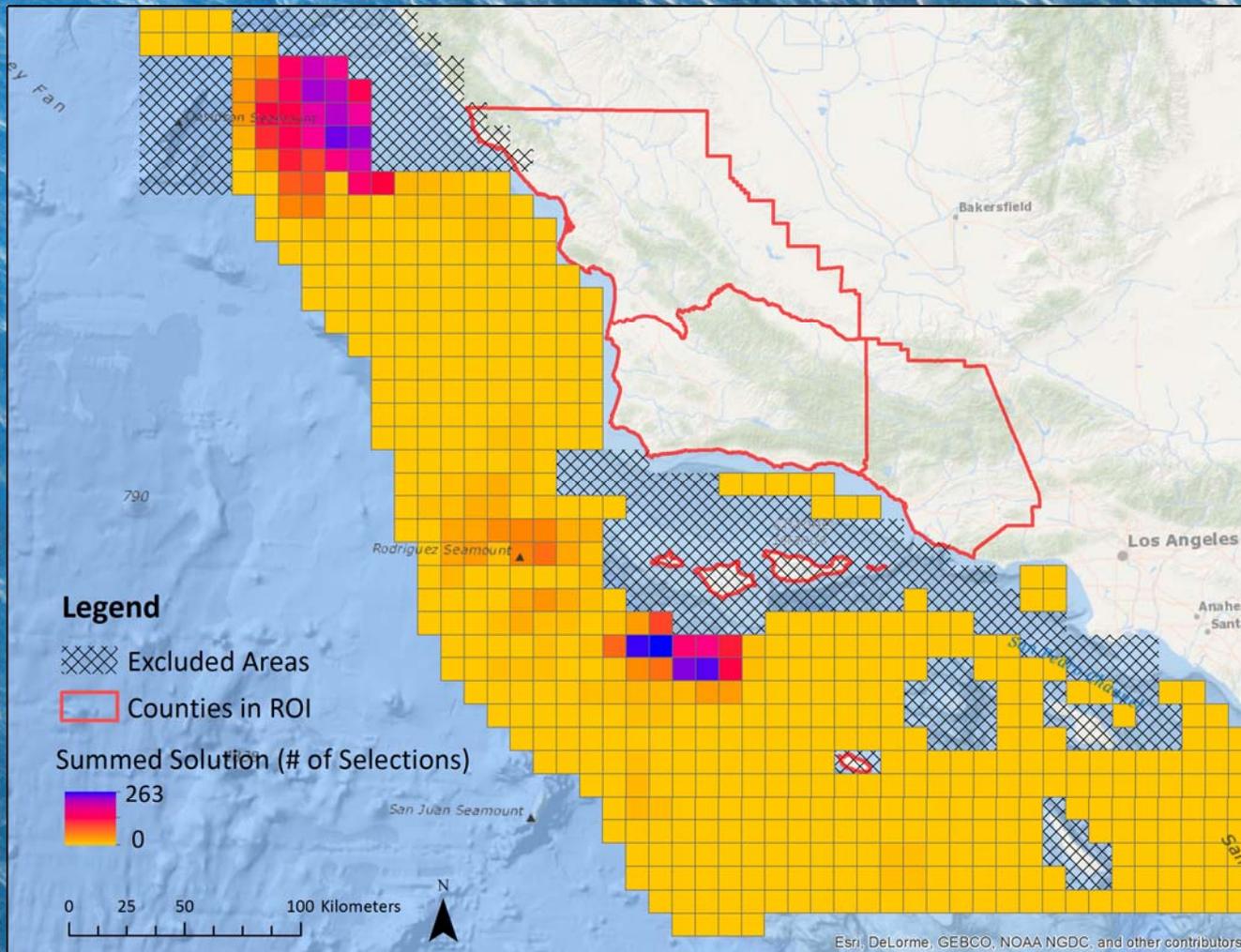
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# Spatial Analysis: Analysis of Results

## Takeaway:

- Central California Coast has offshore wind development potential

## But:

- Imperfect data
- Not all variables considered

# Project Summary

Lens	Barrier	Potential Solution	
Permitting	Uncertain and untested	Streamline process by identifying <i>Wind Energy Areas</i>	
Stakeholder	Opponent concerns	Weight concerns in site selection	 <p>Most Preferred Offshore Wind Locations</p>
Spatial	Incomplete data	Collect baseline data for all relevant stakeholders	 <p>Avian and Marine Mammal Considerations</p>

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# What is the feasibility of offshore wind energy development in Central California?



Photo Credit: NPS



Photo Credit: CINMS



Photo Credit: US Navy



Photo Credit: NOAA



Photo Credit: CINMS



Photo Credit: BOEM

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# Acknowledgements



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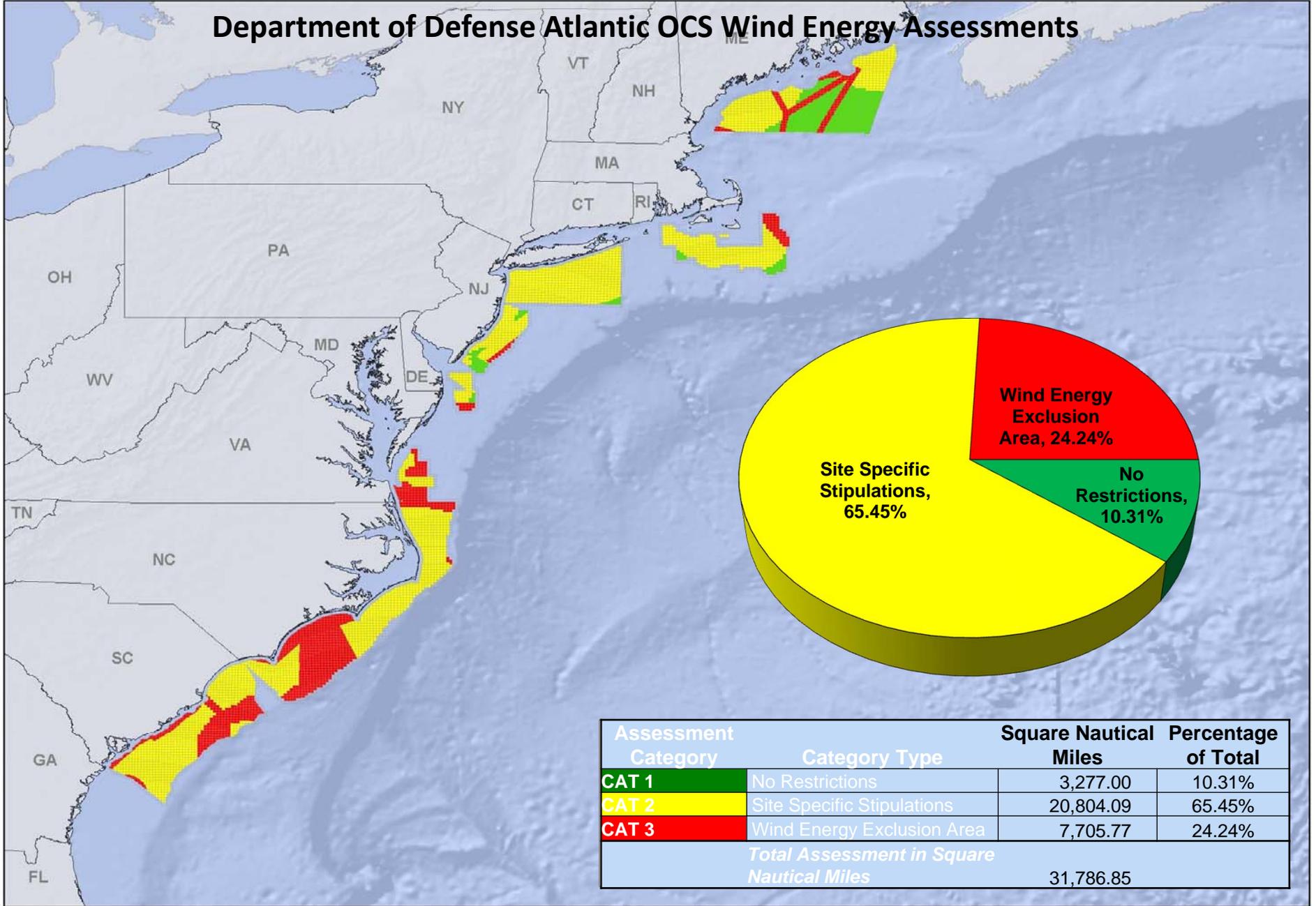


Client:

Matt Riley, CEO

Tom Whitaker

# Department of Defense Atlantic OCS Wind Energy Assessments



Assessment Category	Category Type	Square Nautical Miles	Percentage of Total
<b>CAT 1</b>	No Restrictions	3,277.00	10.31%
<b>CAT 2</b>	Site Specific Stipulations	20,804.09	65.45%
<b>CAT 3</b>	Wind Energy Exclusion Area	7,705.77	24.24%
<i>Total Assessment in Square Nautical Miles</i>		31,786.85	