

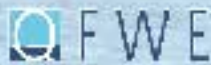
Floating Wind Solutions

Floater Design and Infrastructure Requirements to Enable Industrialized Serial-fabrication on US West Coast

Thomas M Newcomb, Chief Consultant

RAMBOLL

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Quest Offshore

FWS

The Marriott Marquis, Houston 1-3 March 2022

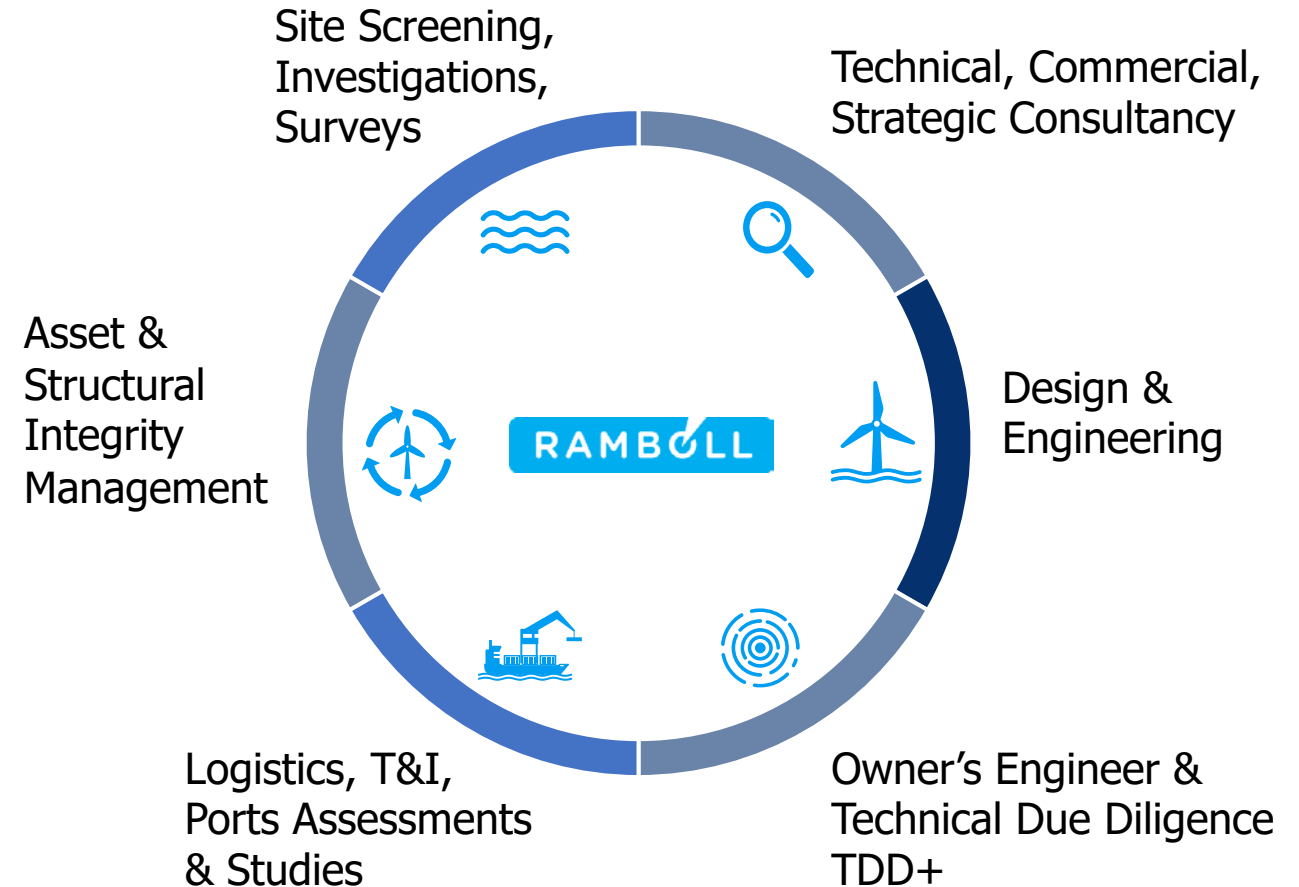
Overview

- Ramboll
- Introduction
- Floater Design Implications on Fabrication
- Floater Design Implications on Ports
- Consideration of California Port Infrastructure
- Summary



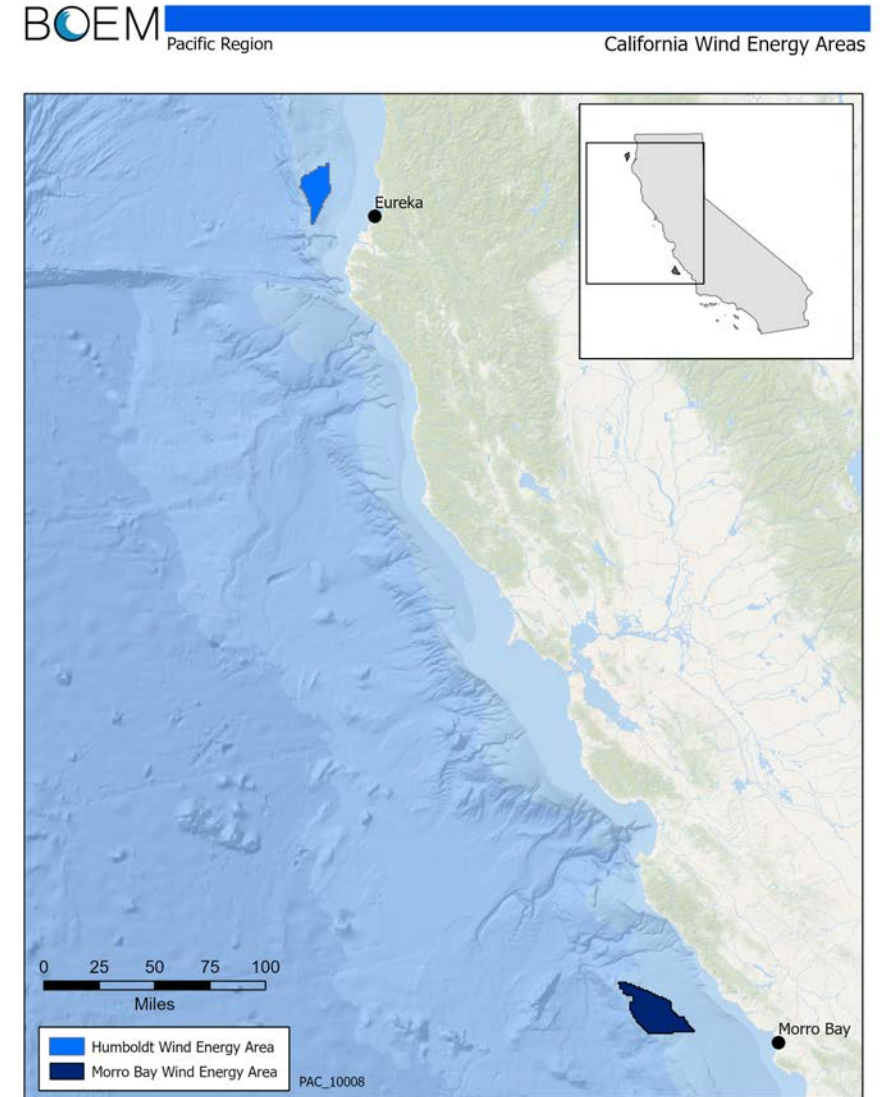
Ramboll

- Ramboll Group: 16,500 employees
- Leading independent Consultancy in Offshore Wind with more than 300 offshore wind experts globally
- Concept and technology agnostic
- Present in all established and emerging markets
- Combining commercial excellence & offshore engineering know-how
- More than 40 commercial and R&D projects in floating wind since 2007
- Dedicated floating wind team covering FOWT specialist topics (coupled analysis, mooring, dyn. cable)



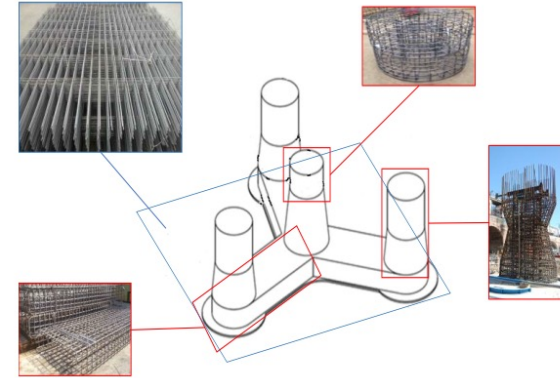
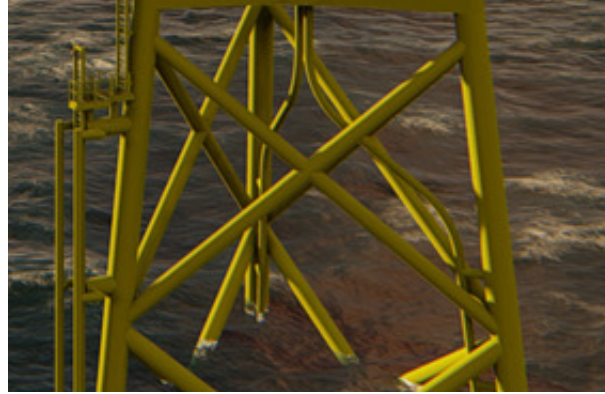
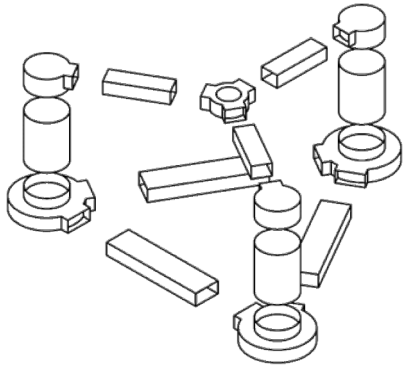
Introduction

- California Technical Offshore Wind Potential of 112 GW
- California to set a goal for offshore wind development by 2045
- Auction later this year for Humboldt and Moro Bay WEAs



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Floater Design Impact on Fabrication



Figures by Ramboll

Large-Volume Steel Structures

Assembled from blocks around 100-350 tons. Assembled structures will have outer dimensions of 75-100m for 15MW class. Mainly stiffened plates.

Slender Steel Structures

Assembled from slender (tubular) elements; "Jacket-type" structures. Different types of joints possible (welded, pins/bolts, grouted, etc.). Mainly unstiffened tubulars.

Concrete Structures (in-situ)

In-situ slip formed or casted in place, using mobile batching plants. Single block or few large blocks. Steel armoring & post-tensioning. Integrated steel interfaces.

Concrete Structures (modular)

Prefabricated concrete modules. Assembled at central assembly area. quayside; different types of joints. Integrated steel interfaces.

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Design Implications on Fabrication and Logistics

Dimensions and Masses

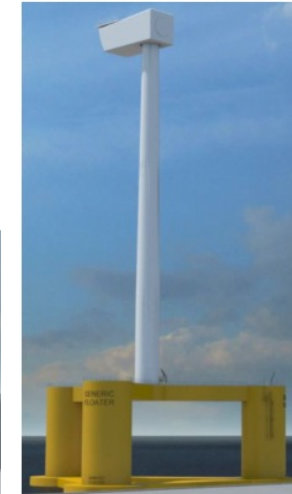
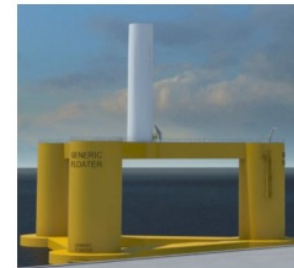
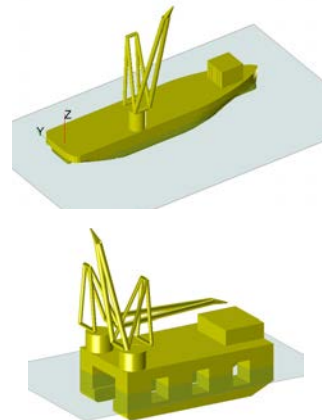
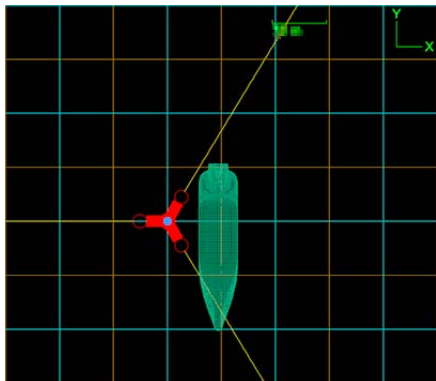
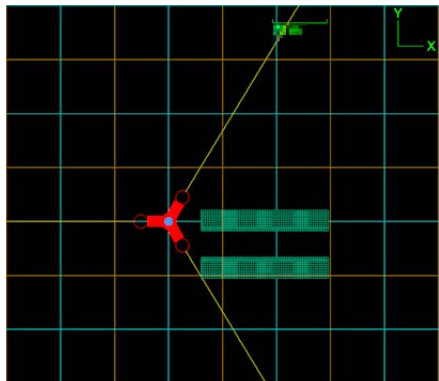
- Implications on fabrication facilities, port, storage/buffer strategy (area, draft, crane, ground bearing, etc.)

Stability/Draft During WTG Integration and T&I

- The stability of the floater in different loading conditions and the installation process govern the quayside and on-site procedures and vessels / cranes / infrastructure required

WTG-Floater Integration Quayside vs. Offshore

- Depending on vessel availability, capacity, floater stability and weather conditions, it will have a major impact on the logistics strategy (local staging/marshalling port required or a global)

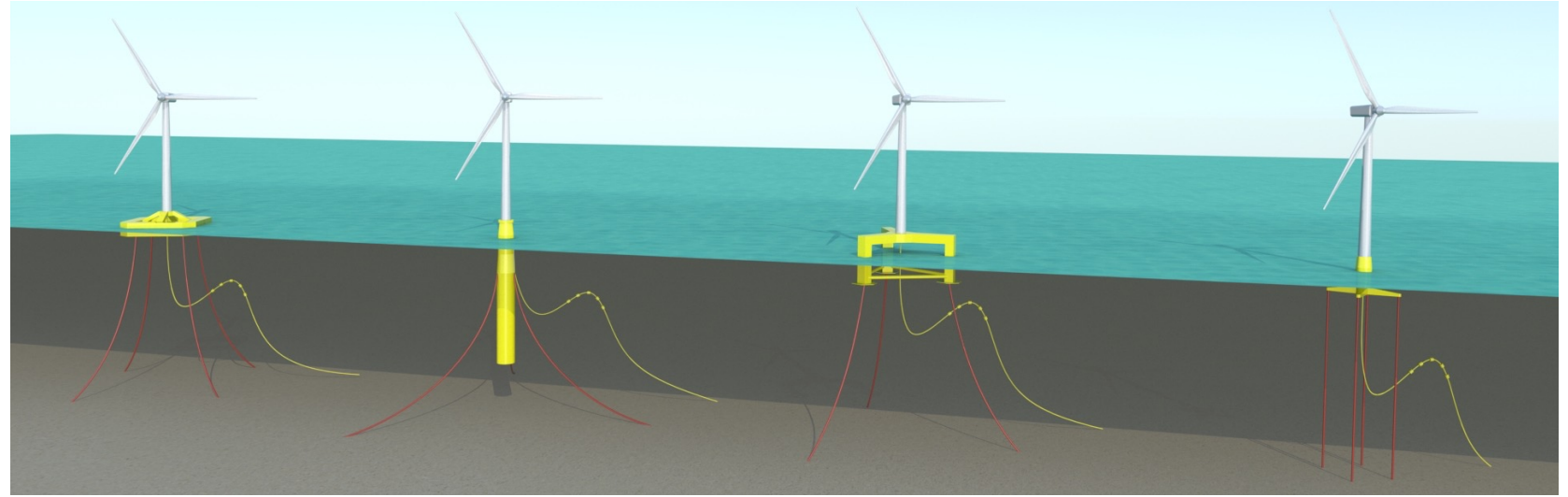


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Floater Design Implication for Ports

Floater Design

- Floater dimension very widely across technologies
- Port assembly and towing draft is a key consideration

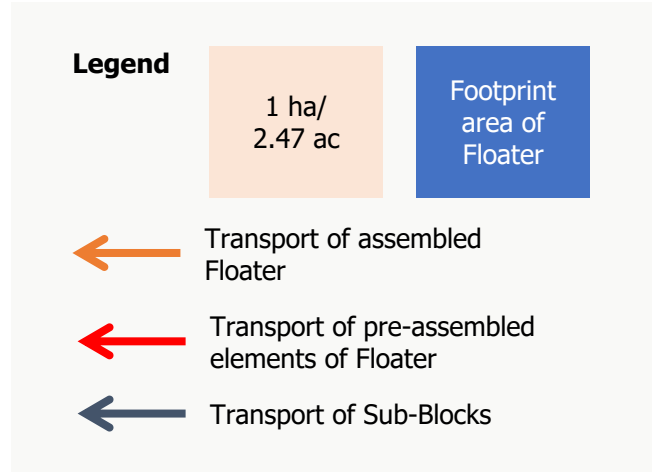
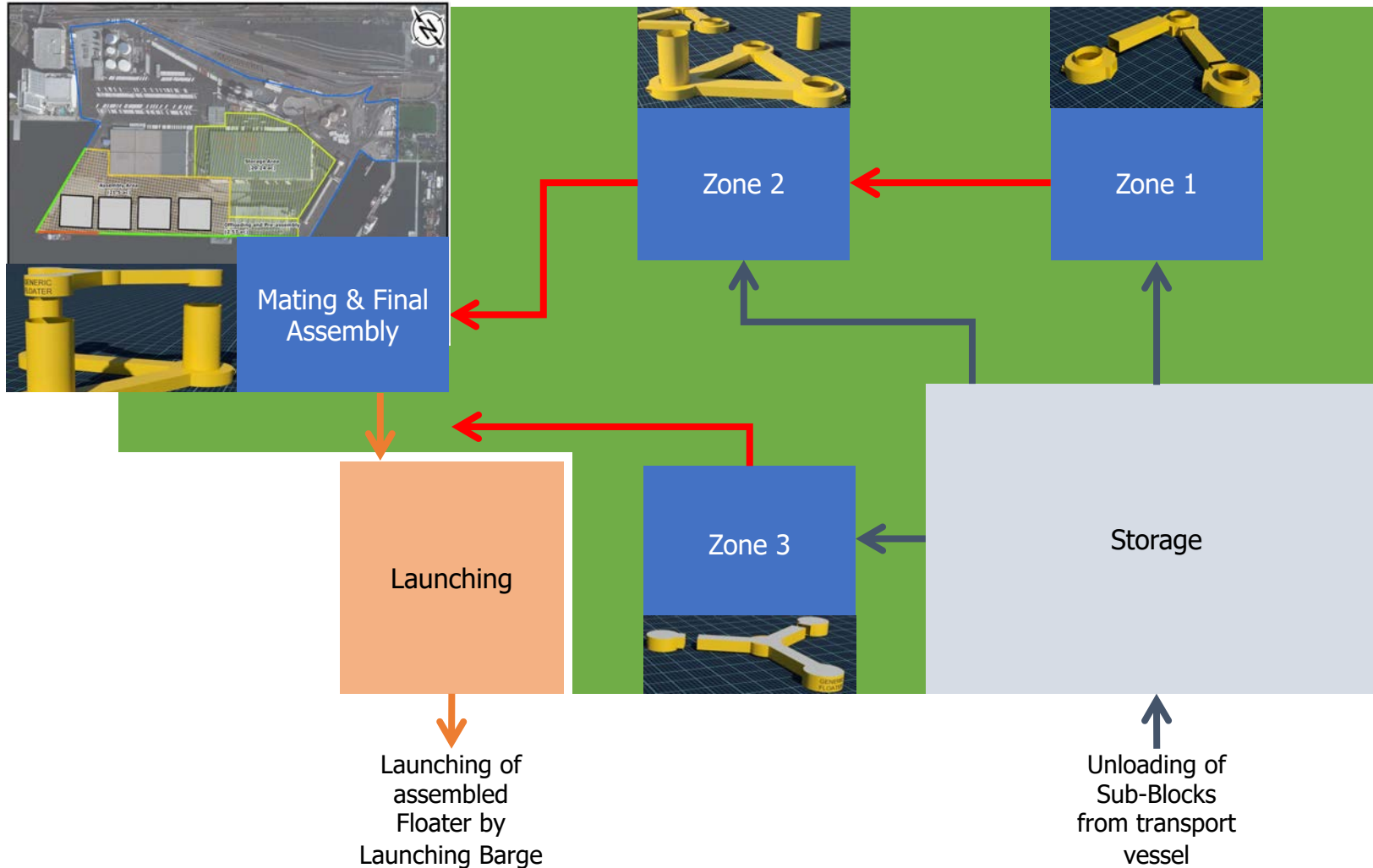


General Floater Archetype (15 – 20 MW)	Barge	Spar	Semi-Submersible	TLP
Outer Box Dimensions (L x B x H; excl. TP)	L: 55-65 m, B: 55-65 m H: 15-20 m	Ø: 20-25 m H: 100-140 m	L: 70-90 m, B: 80-100 m H: 35-40 m	L: 70-90 m, B: 80-100 m H: 35-55 m
Operational Draft	10 – 15 m	85 – 120 m	20 – 30 m	20 – 40 m
Port Assembly Draft (with tower & WTG)	5 – 10 m	85 – 120 m	5 – 20 m	5 – 10 m

Generic figures provided in the table are to illustrate the large variety of dimensions between floater concepts and within each concept type.

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Assembly Port Considerations

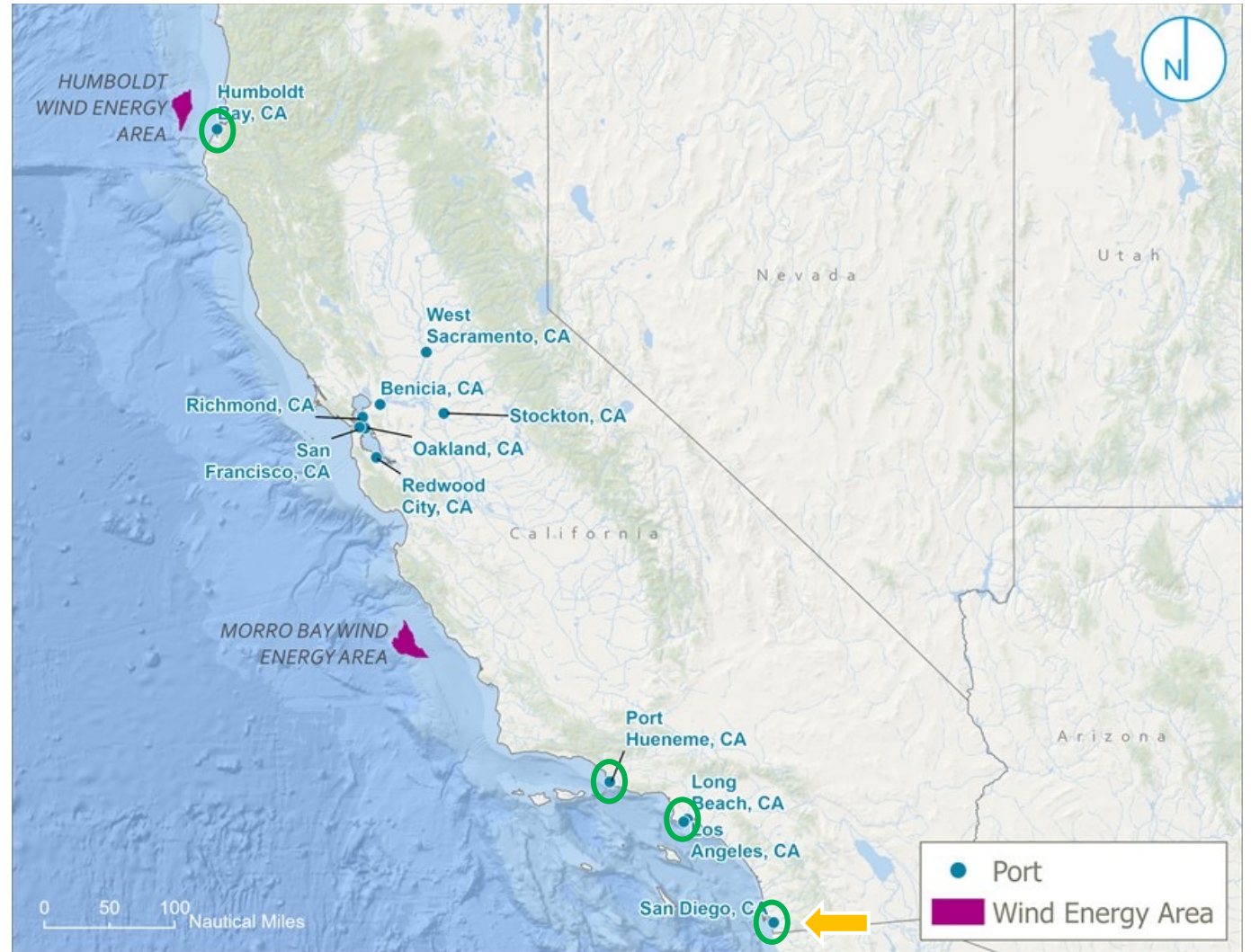


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Existing infrastructure and supply chain in CA

Floating Wind Port Activities

- Floater Assembly
- Turbine Integration
- Fabrication of Components/Blocks



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Summary

- Cost-effective commercial floating wind projects in California will require industrialized serial production
- Floater design for California projects must consider the fabrication strategy and port infrastructure available
- Existing California port infrastructure will require significant investment to support local offshore wind fabrication and assembly



Thank You

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