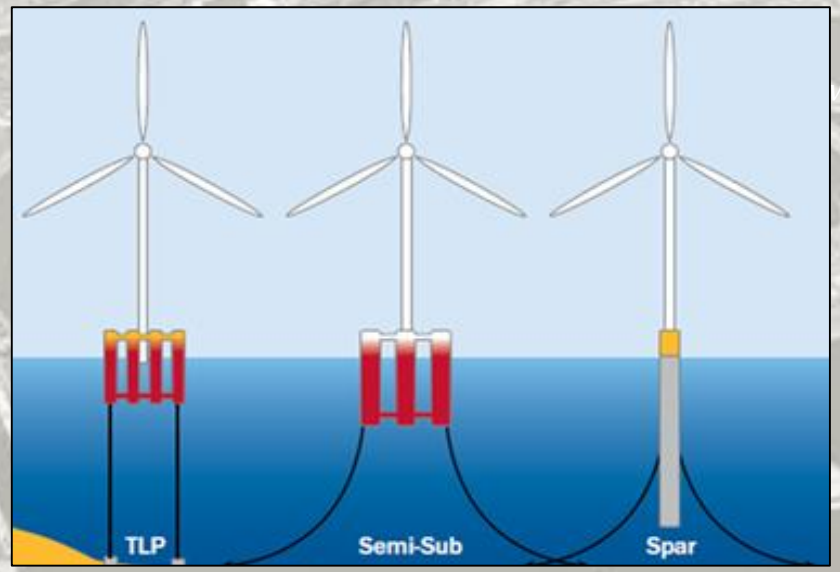
Port Infrastructure to Support Floating Offshore Wind – West Coast USA

Focus on California



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Mott MacDonald
Seattle, WA

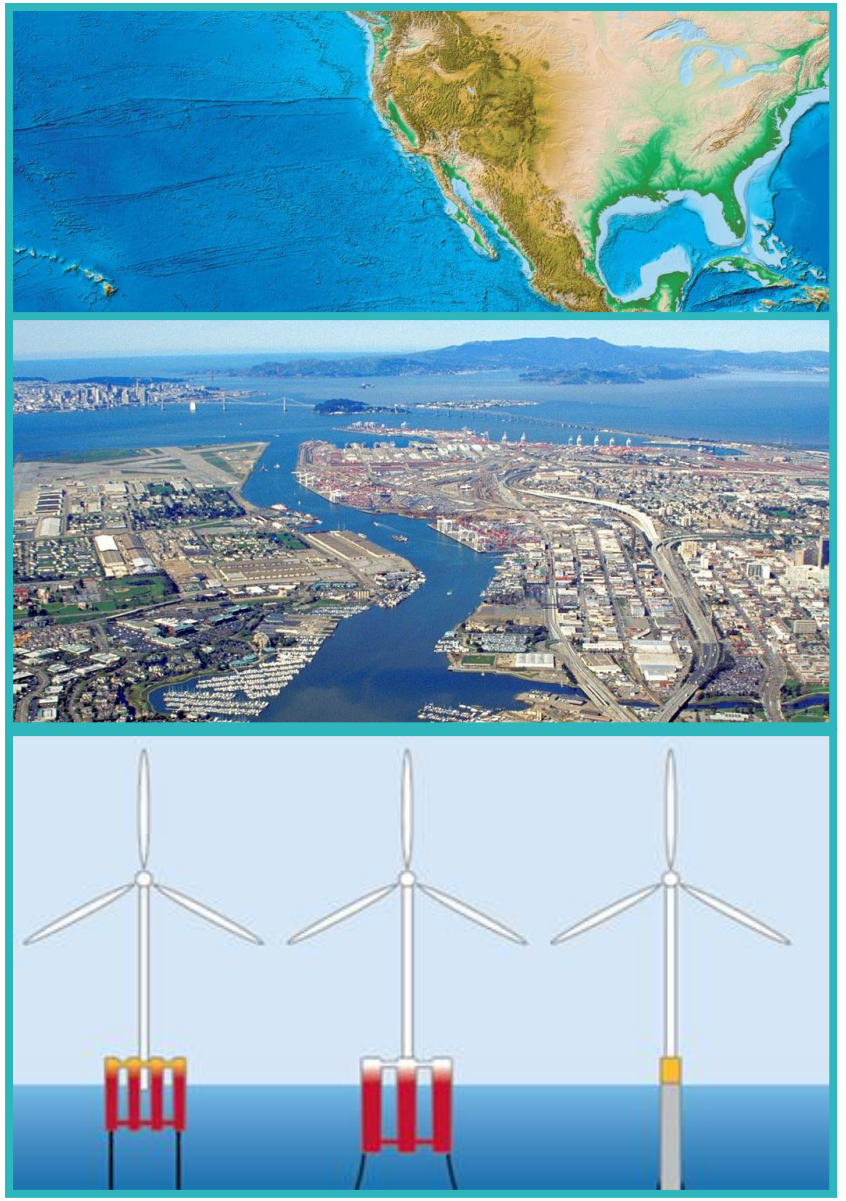
OCS Study
BOEM 2016-011

BOEM Project Manager:
Mark Eckenrode

Objectives

1. **Estimate port infrastructure requirements to support floating offshore wind .**

2. **Assess existing and potential future capability to support demonstration-scale and utility-scale projects.**



Note: Not focused on traditional foundation offshore wind

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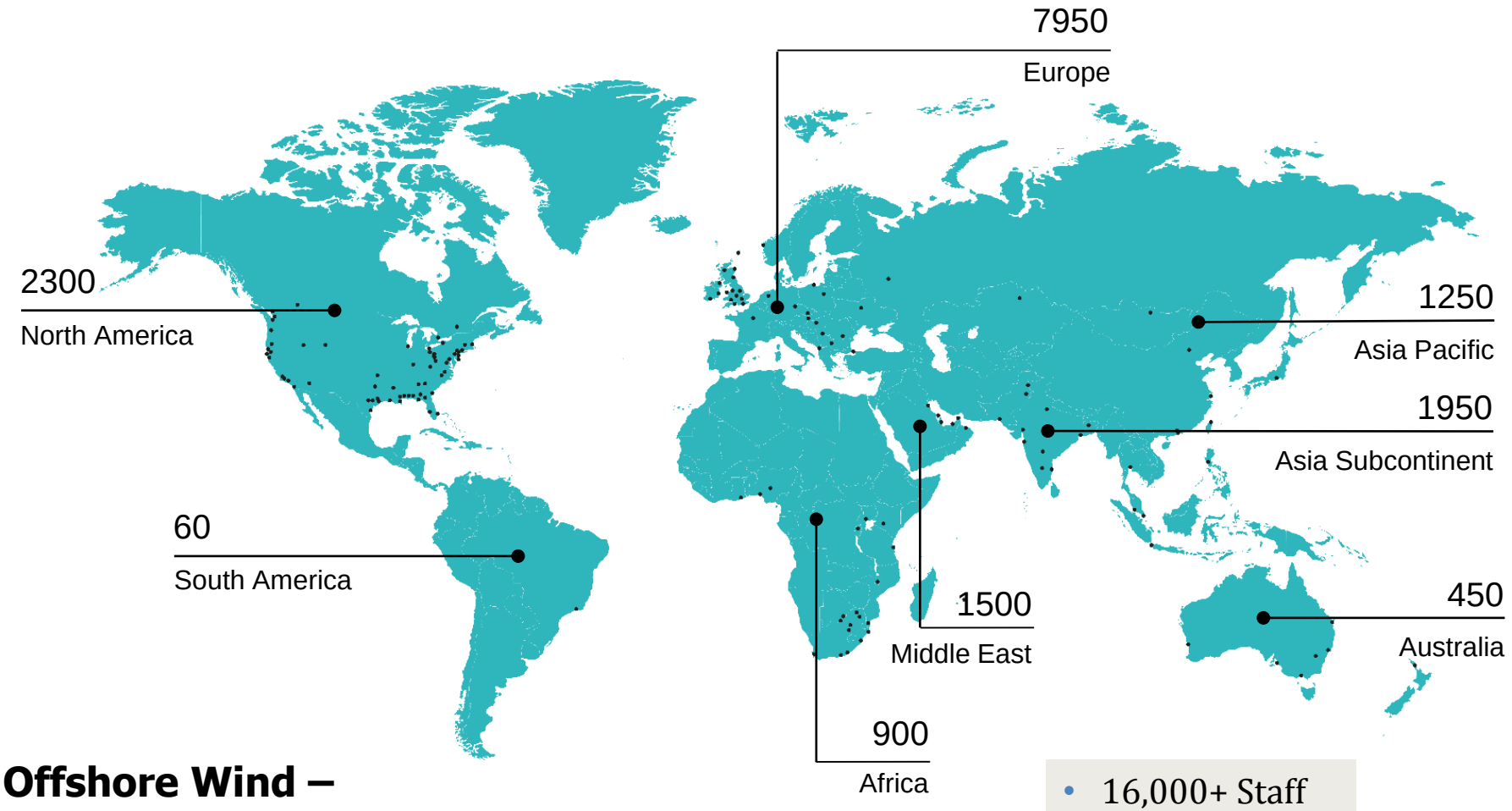
Block Island Wind Farm: Lender's Technical Advisor



Offshore Wind – Engineering & Advisory services over 20+ years

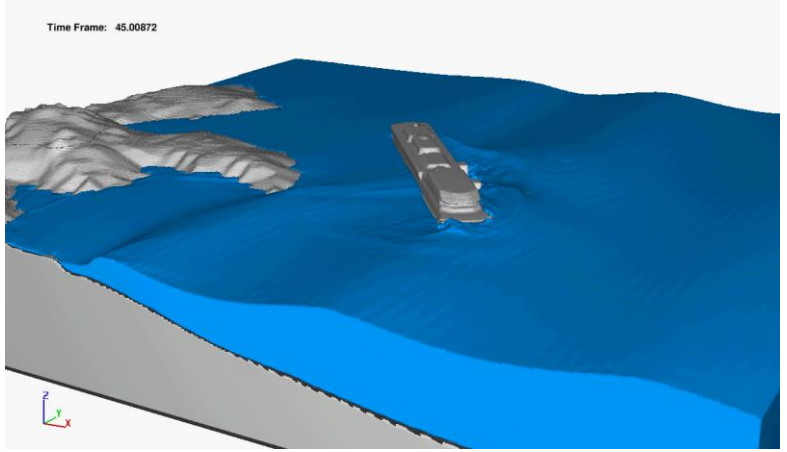
Capewind	*Gemini*
Fishermen's Energy	*Walney*

- 16,000+ Staff
- 150 Countries

Ports/Coastal Practice

- Navigation
- Vessel Maneuvering
- Dredging
- Port and Harbor Facilities
- Marine Terminals
- Coastal Processes
- Coastal and Hydraulic Design
- Coastal Structures
- Coastal Hazards

Costa Concordia Salvage – Met-ocean & Wave Force

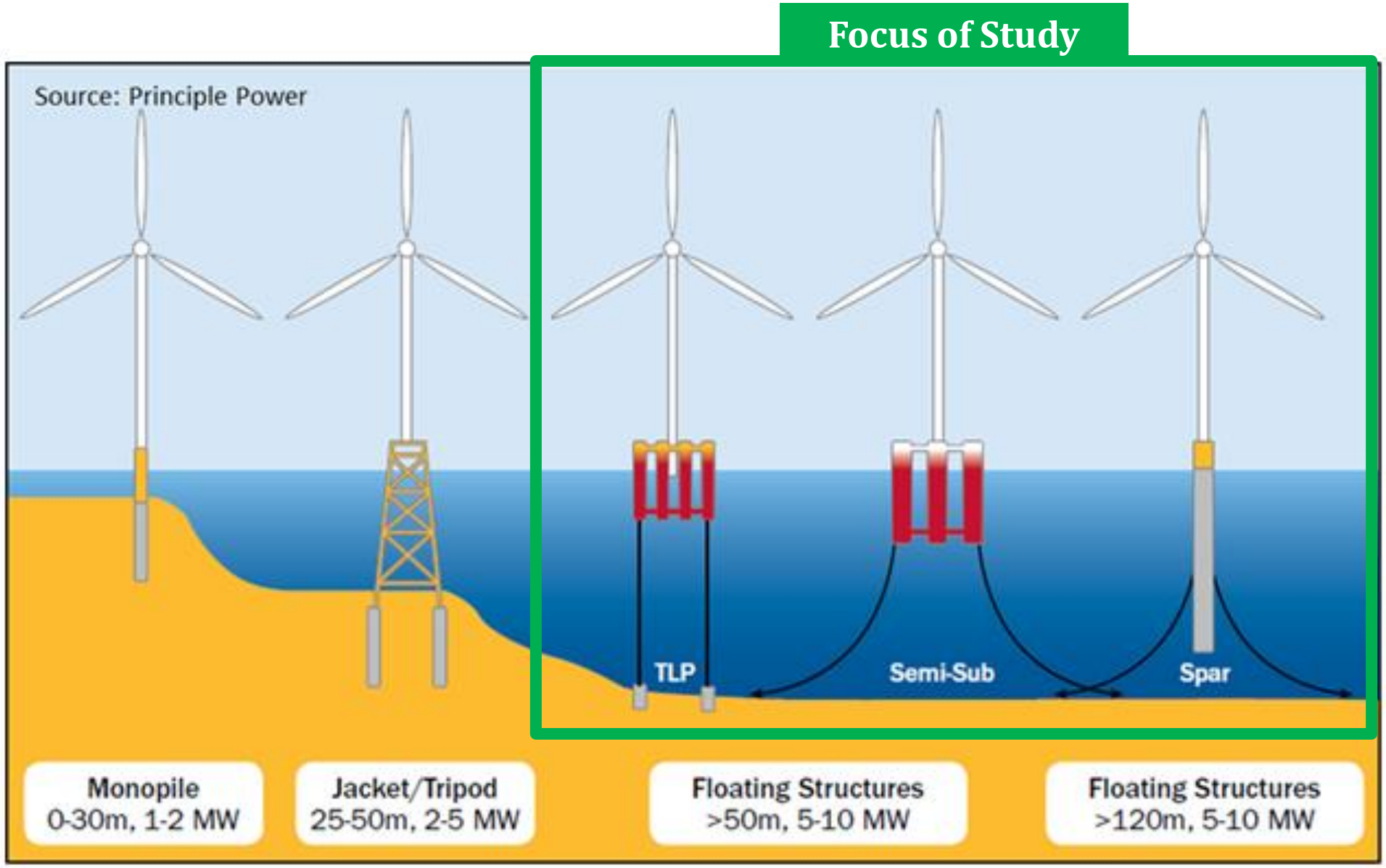


Passing Vessel & Mooring Analysis

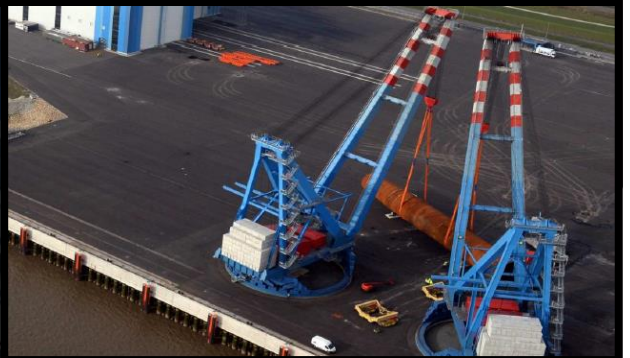
Coastal Structures

Dredging

Basis of Analysis - Devices



Source: Siemens

Source: Principle Power


Considerations

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Transport

- Nav. Channel Width
- Nav. Channel Depth
- Height Restrictions
- Device Type
- Metocean Conditions
- Vessel Availability
- Component Size
- Quick Response

Infrastructure

- Skilled Labor Force
- Quayside Space
- Road/Rail Connection
- Component Size
- Device Type
- Crane Capacity
- Quayside Bearing Capacity
- Dry-dock/Shipyard
- Vessel Availability
- Vessel Berths

Input: Marine Contractors, Ports, Developers, Literature Review, Conceptual-level engineering

Geographic Extents - BOEM Study

<u>CA - Large Ports</u>

Northern

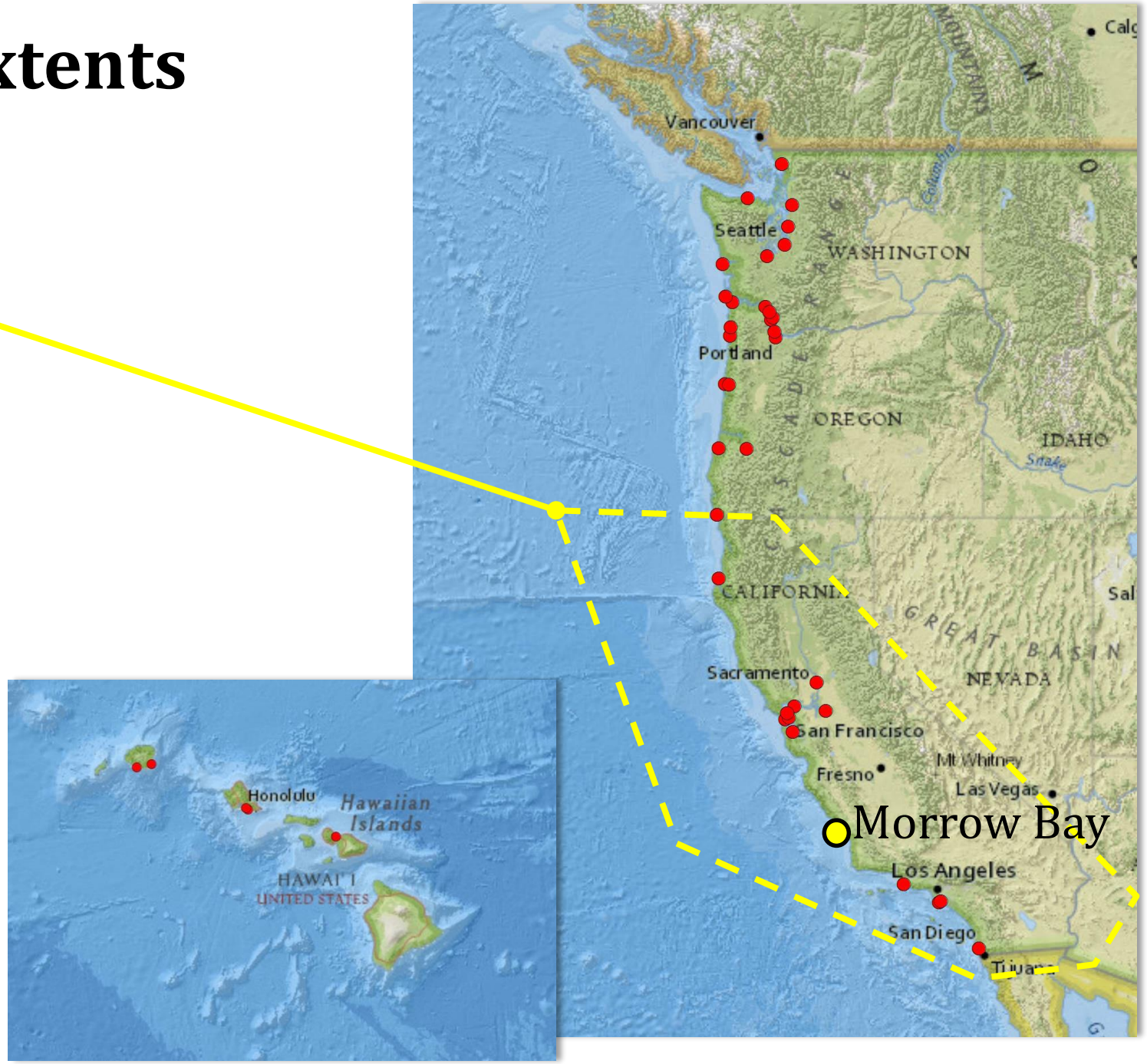
- Humboldt Bay

Central

- SF Bay

Southern

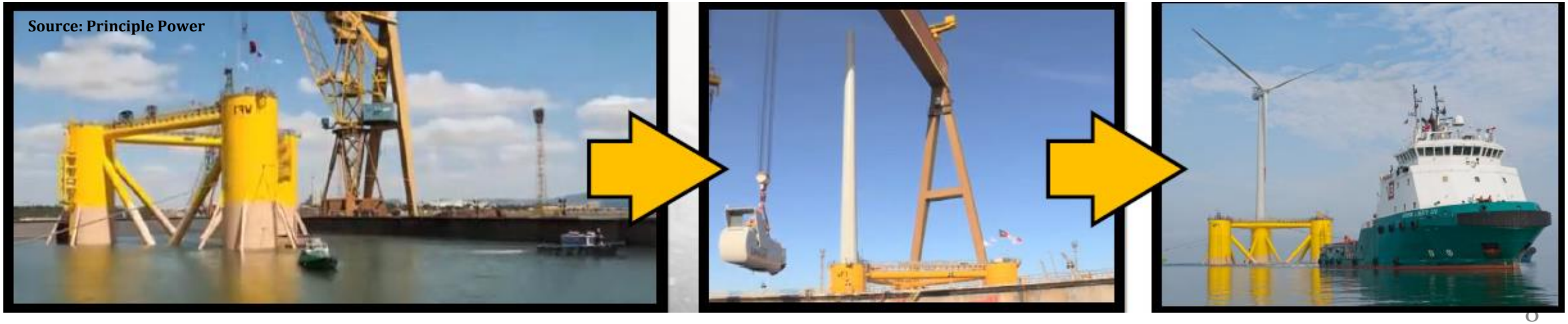
- Hueneme
- Los Angeles
- Long Beach
- San Diego



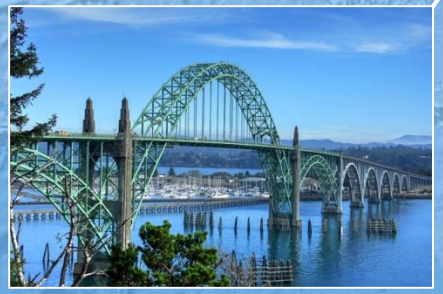
Prototype Assembly

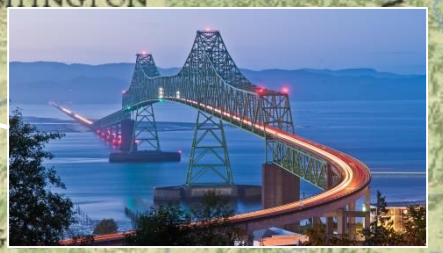
Protected Water

Port



Ports – Air draft Restrictions

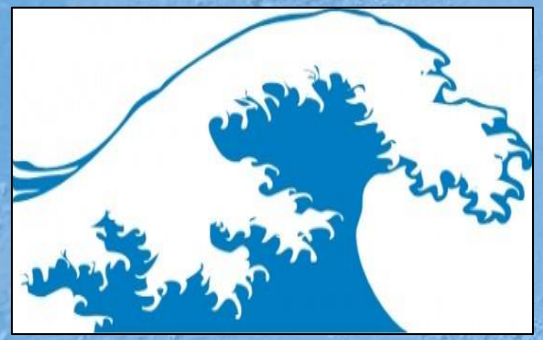




Limits Assembly Location or Installation Method

Metocean Conditions

PACIFIC OCEAN



WA, OR, CA, HI Average, Typ.	Winter	Summer
Hs (ft.)	9-10ft.	6-7ft.
Tp (sec)	11-12 sec	9-10 sec

- Harsh Environment
- Long Waves, deep water
- Protected Harbor/Alternative Installation Scheme

Key Findings – Port Infrastructure

1. Offshore Construction Infrastructure

- Few facilities optimized for offshore construction on US Pacific Coast (unlike Gulf)

2. Ocean Conditions

- Pacific Ocean: Depth & Wave height, length
- Europe: Shallower seas

3. Harbors

- Assembly or port-based maintenance: No air draft restriction, wide channel, deep draft channels, adequate acreage

4. Infrastructure

- High reach (~300ft.), heavy-lift (~500-1000 ton) cranes
- High bearing capacity wharf (1000-4000 psf)
- Quayside upland area (25–100+ acres)

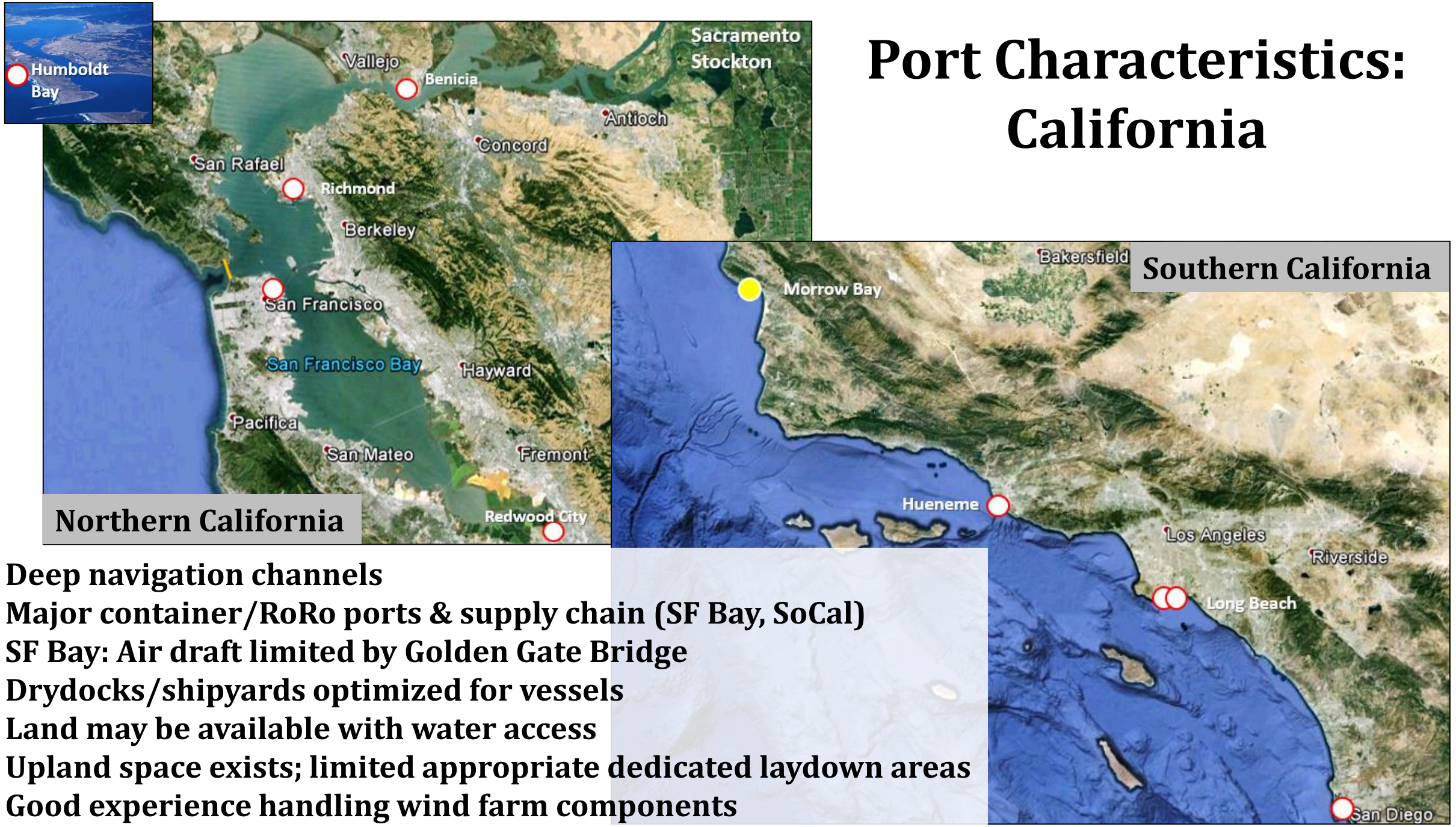
5. Marine Transport

- Long tow distances common
- Minimize CapEx
- Pilot Projects
- Potentially combine assembly and major maintenance facility

6. Transportation

- Overland connections for smaller component
- Large components fabricated at site w/water access

Port Characteristics: California



- Deep navigation channels
- Major container/RoRo ports & supply chain (SF Bay, SoCal)
- SF Bay: Air draft limited by Golden Gate Bridge
- Drydocks/shipyards optimized for vessels
- Land may be available with water access
- Upland space exists; limited appropriate dedicated laydown areas
- Good experience handling wind farm components

Conceptual Case Study (LA, LB)

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Figure: Principle Power

Photo: Fred Olsen

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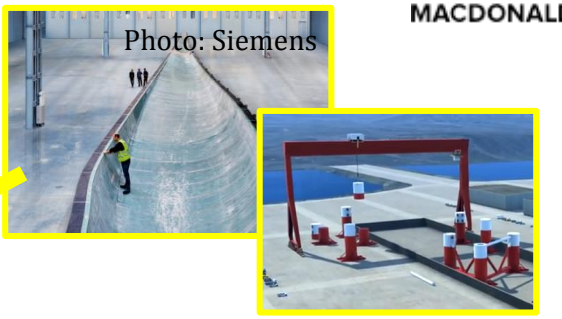


Photo: Siemens

Figure: Principle Power

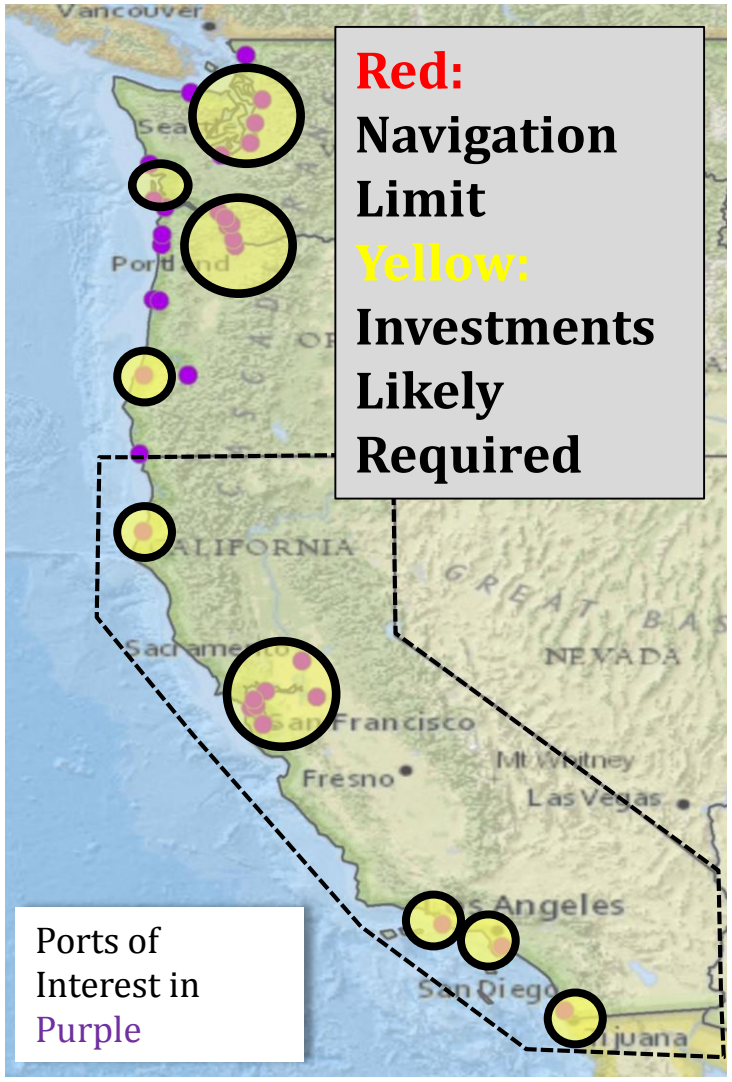
Inner Harbor: Air Draft or other navigation restrictions.
Outer Harbor: No Air draft or other navigation restrictions
Open Ocean: Depth and wave conditions affect equipment use (existing technology only)

Note: Existing technology only.
Figure not intended to evaluate specific port or terminal

YELLOW – POTENTIALLY FEASIBLE W/INVESTMENT & OTHER LOGISTICAL DETAILS ORANGE– NOT LIKELY FEASIBLE

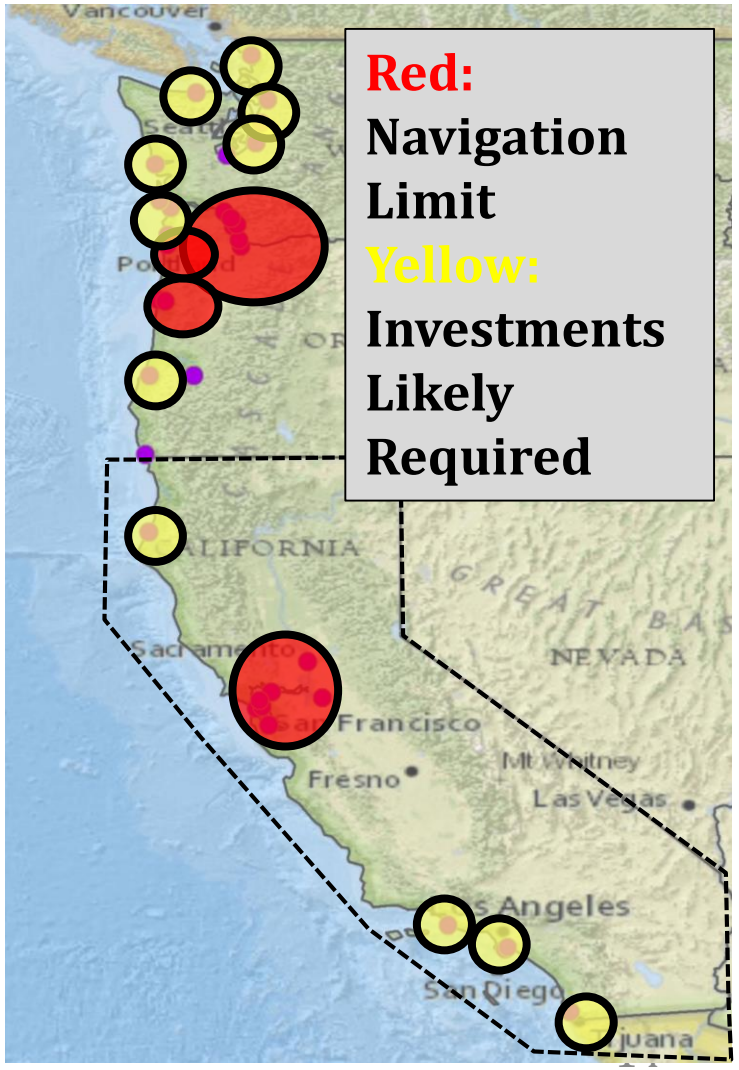
Key Findings – Ports

Fabrication



- Port infrastructure investment likely required at varying levels. Both fabrication & assembly
- Air draft limitations for upright FOWT in CA and West Coast
- Potential for Port Network
- Operations Base (not shown): Long-term. Access via helicopter, vessel, or floating at-sea base

Tow-out



Summary/Questions

Wave/depth conditions offshore → Equipment downtime, seek protected waters

California → Good workforce, overland connections, and existing upland infrastructure

Nav. Restrictions → Bridges and Nav. channels may limit options for towing assembled devices

Marine long distance towing → Assembly/maintenance facility & operations base may be located apart (Port Network)

Capable Ports → Use of larger ports' outer harbors may require land repurposing & bearing capacity invest.

Ports will be key:

- Assembly
- Maintenance
- Operations
- Fabrication

Questions

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