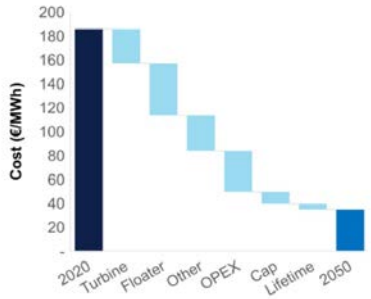
FOW and Ports Infrastructure – Synergies & Challenges

Noé Rouxel – Floating Wind Lead, North America
DNV – Offshore Wind Advisory

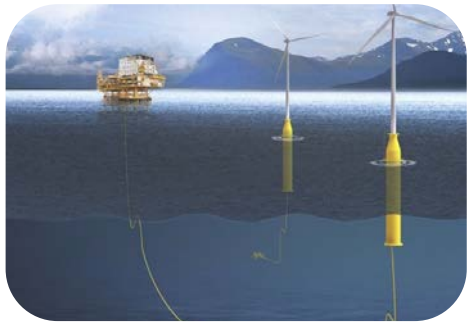
DNV's Floating Wind activities:

Feasibility studies, pre-dimensioning, tech. benchmarking



Cost modelling / lease area valuation

Ports and infrastructure assessment

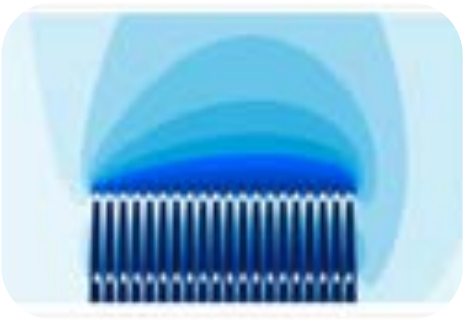


Transmission strategy and technology

Permitting (SAP, COP, NSRA, EIS…)

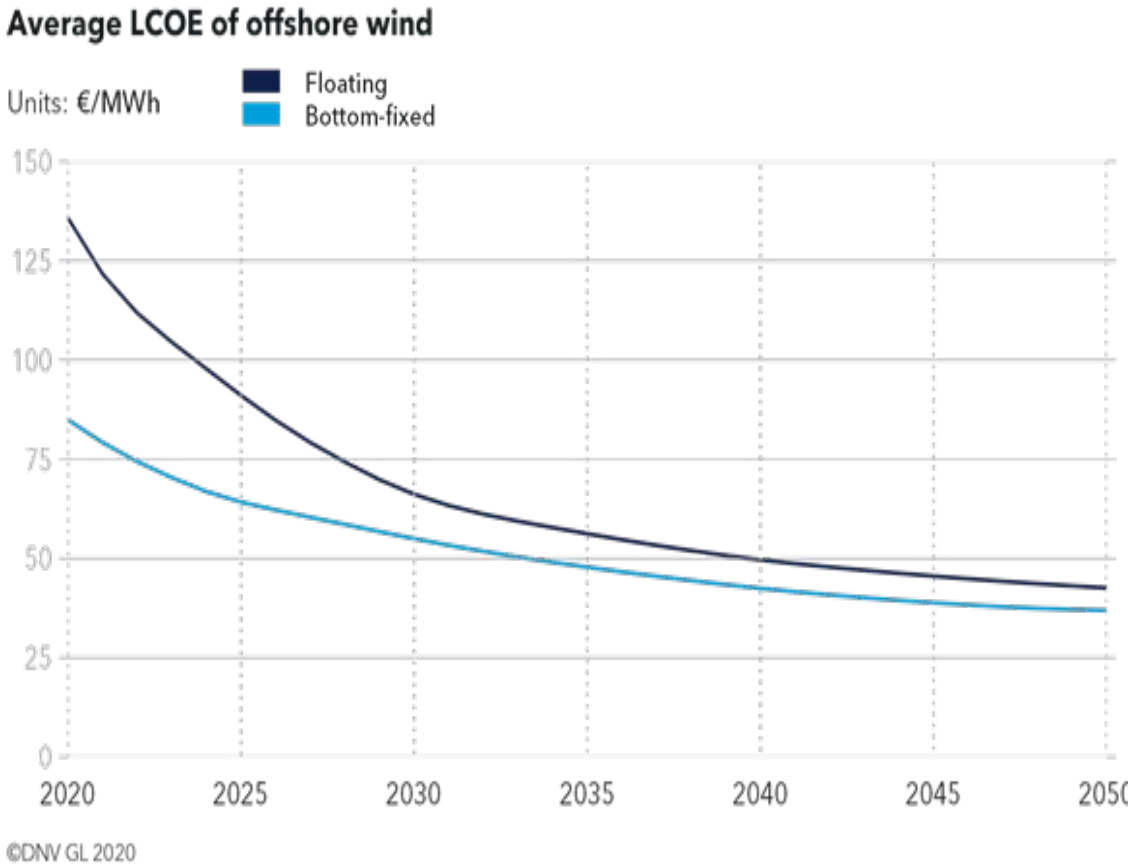
Certification (CVA) & Classification

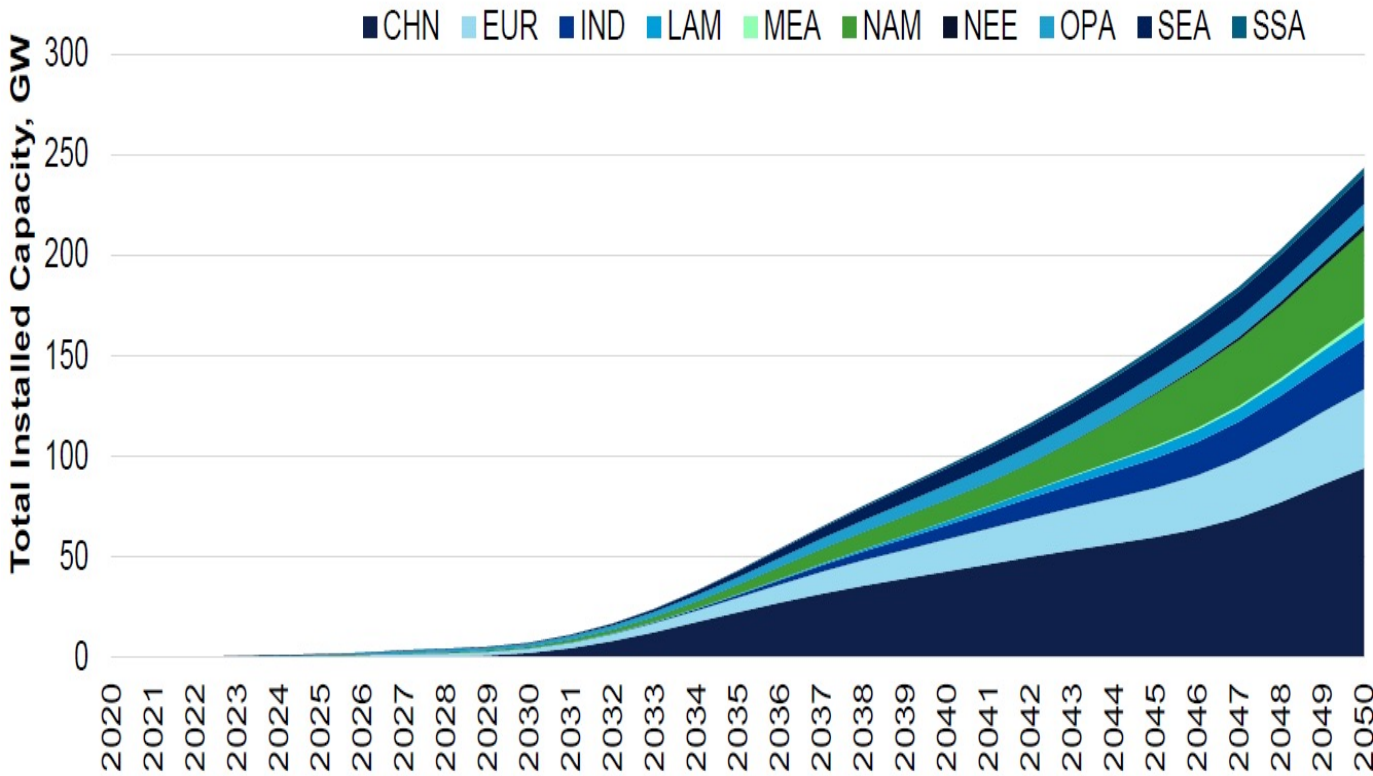
Technical Due Diligence & LTA



Energy Assessments

DNV's Floating Wind LCoE Forecasts
By 2050: **80%** reduction in LCOE and **2000** fold growth





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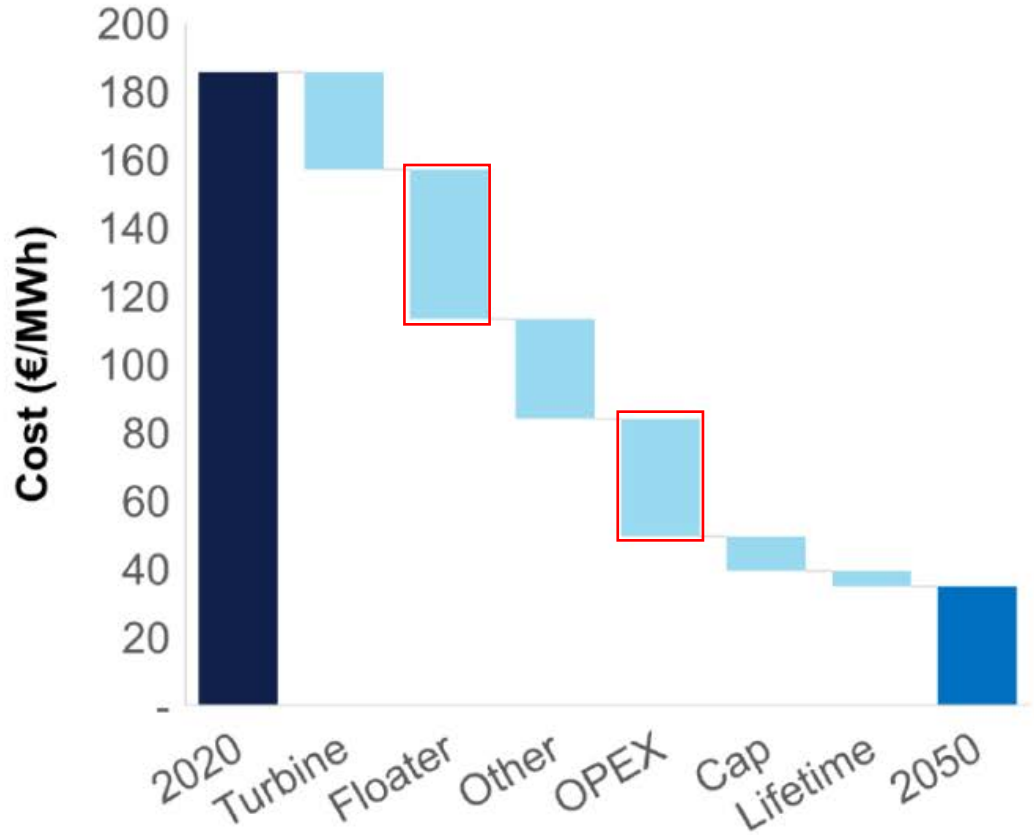
Several Factors Leading to Cost Reduction



Key Drivers

- Larger windfarms
- Cooperation and sharing
- Financial incentives
- Auctions
- Larger wind turbines
- Reduced risk
- Standardisation
- Technology development
- Industrialisation
- Construction and operational experience
- Higher capacity factors
- Longer lifetime

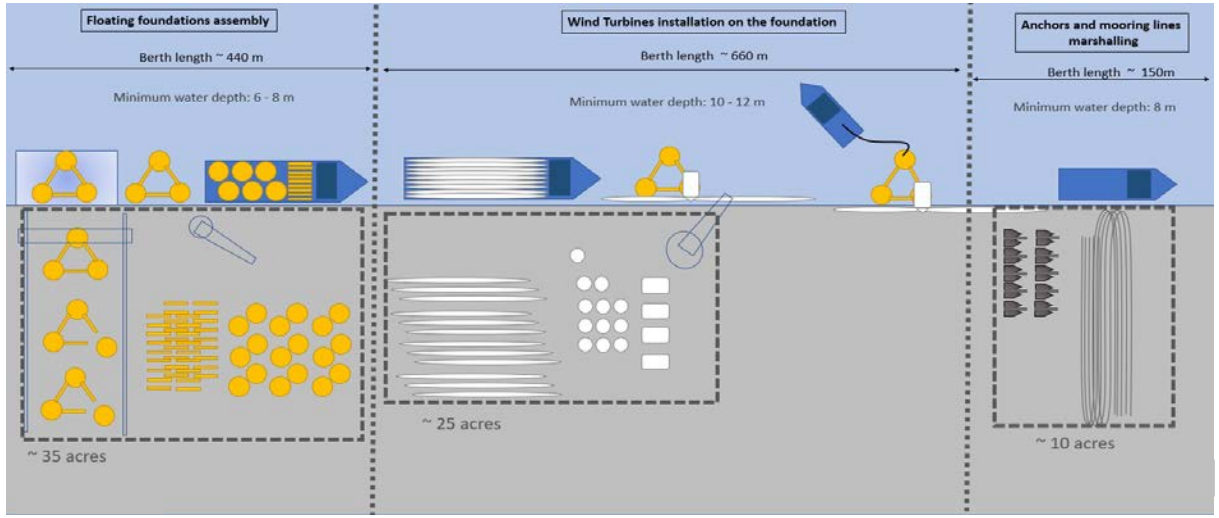
Construction & ports infrastructure as common denominator for cost reduction of Foaters and OPEX

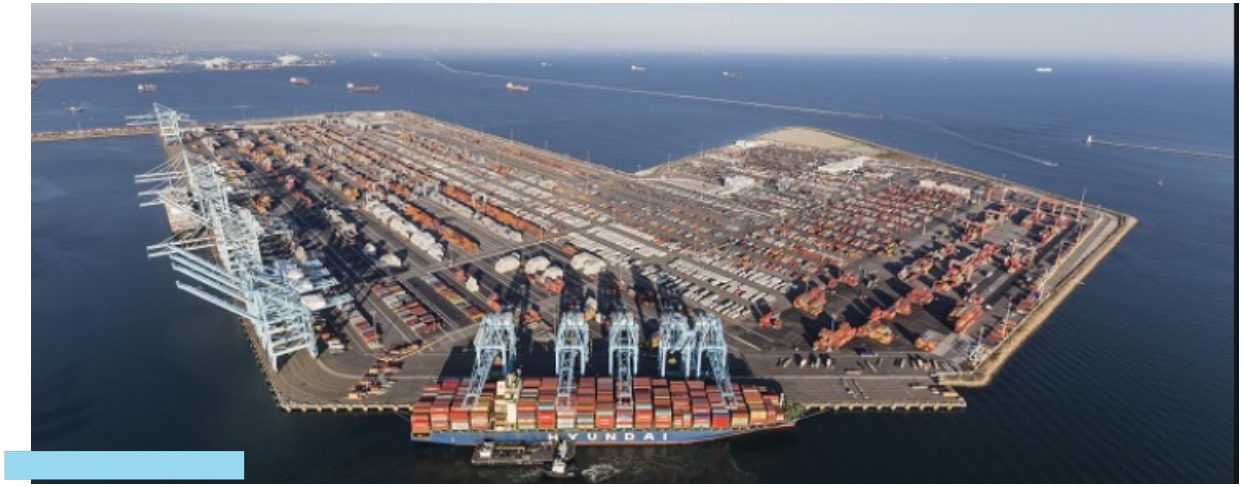
Floating Wind development generate more port infrastructure needs than bottom-fixed

- Increased mass and volume of the foundations
- More construction activities in port
- Floating foundation assembly and commissioning
  - Integration of the turbine on the foundation
  - Deeper draft required

- Laydown area ↗ + 300 %
- Berth length ↗ + 400 %
- Water depth ↗ 0 to +50 %
- Different equipment: cranes, launching docks, …

Current conditions required for FOW are challenging





- The current port infrastructure was not designed for FOW and usually needs:
  - Deeper draft
  - Higher bearing capacity
  - Heavy lifting construction cranes
  - Vast laydown areas
- Different characteristics than most shipping ports
- Existing ports are already extremely congested

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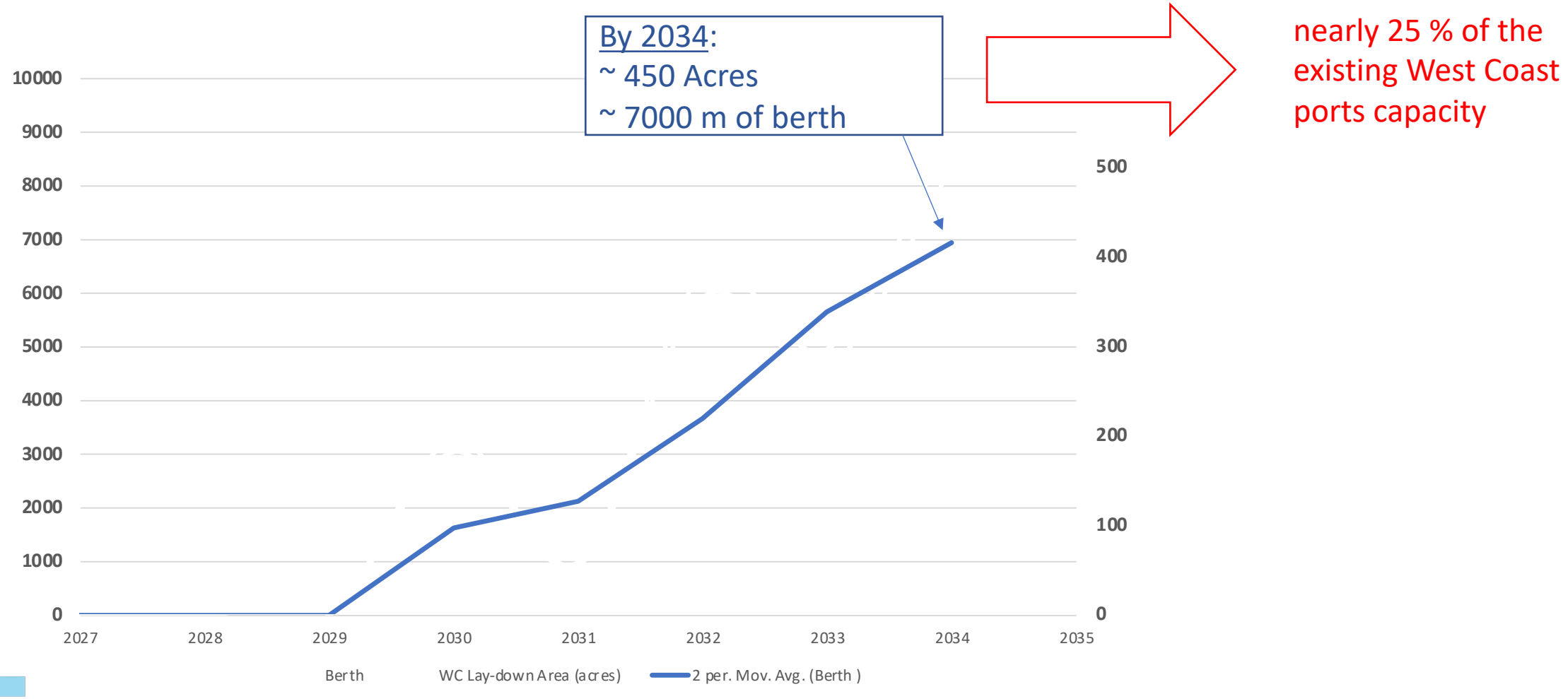
Port Requirements – US west coast example



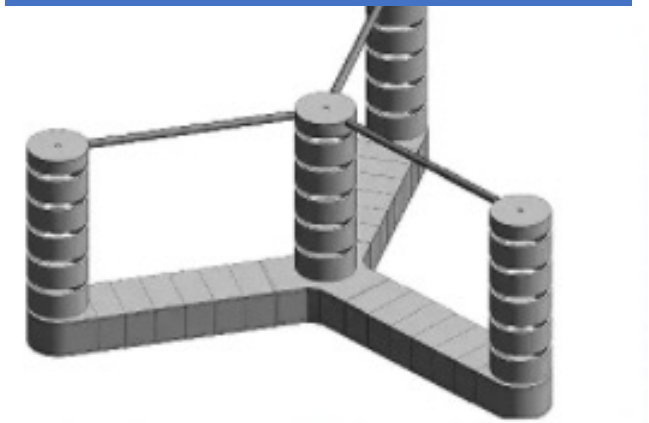
nearly 25 % of the existing West Coast ports capacity

3 main axis to make it happen

Invest and increase ports space

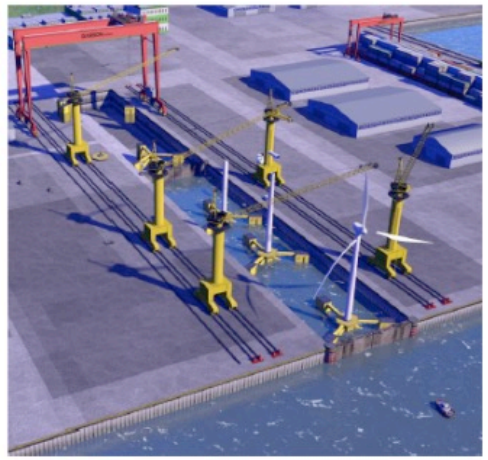
Higher degree of industrialization

Adapt and diversify floater concepts to the infrastructure

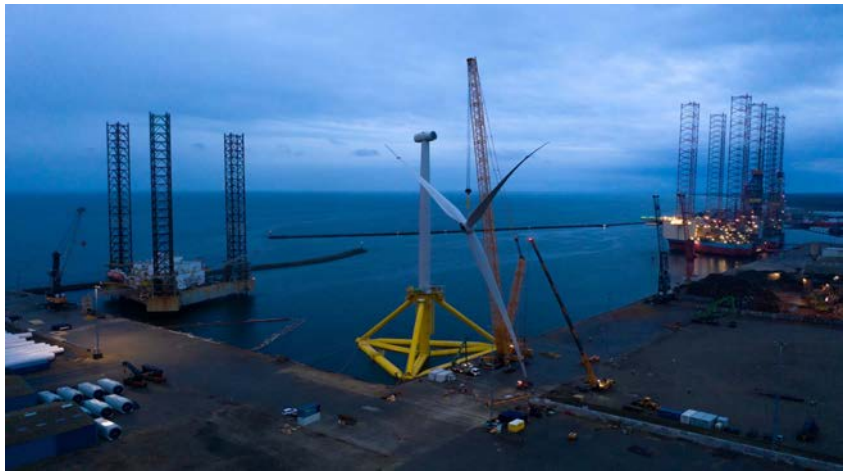


Floating Wind industry scaling & infrastructure

- FOW transitioning into industrialization stage
- Scaling and industrialization needs will shape port investments
  - Hull Fabrication lines
  - Hull assembly facilities (drydocks, lifts…)
  - WTG integration berth and cranes
  - Marshalling of construction and O&M

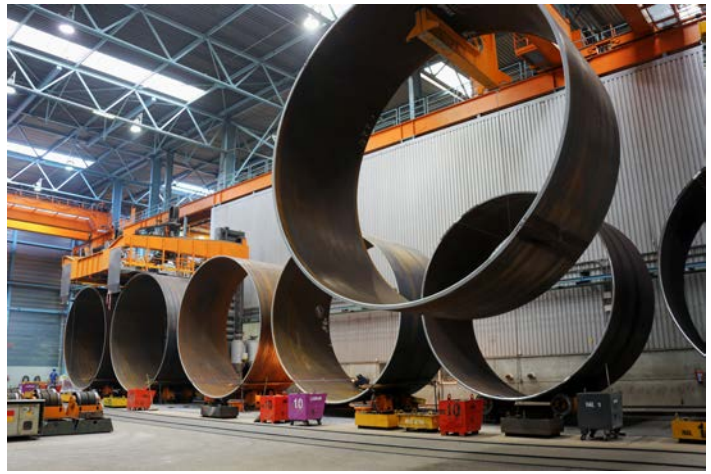


Innovations in floaters concepts to facilitate the construction



Reduced WTG integration draft

-> flexibility of integration locations



Standardisation of elements

-> efficient industrialisation

Diversification of materials (concrete / steel)

-> Diversify the supply chain and enable more local content

Other strategies to get around ports limitations

- Jack-up vessels or other construction vessels/barges as temporary construction dock (floating-to-floating WTG integration).
- Long distance transport of fully-assembled floating foundations from other locations

- ➢ Increased costs
- ➢ Less local content

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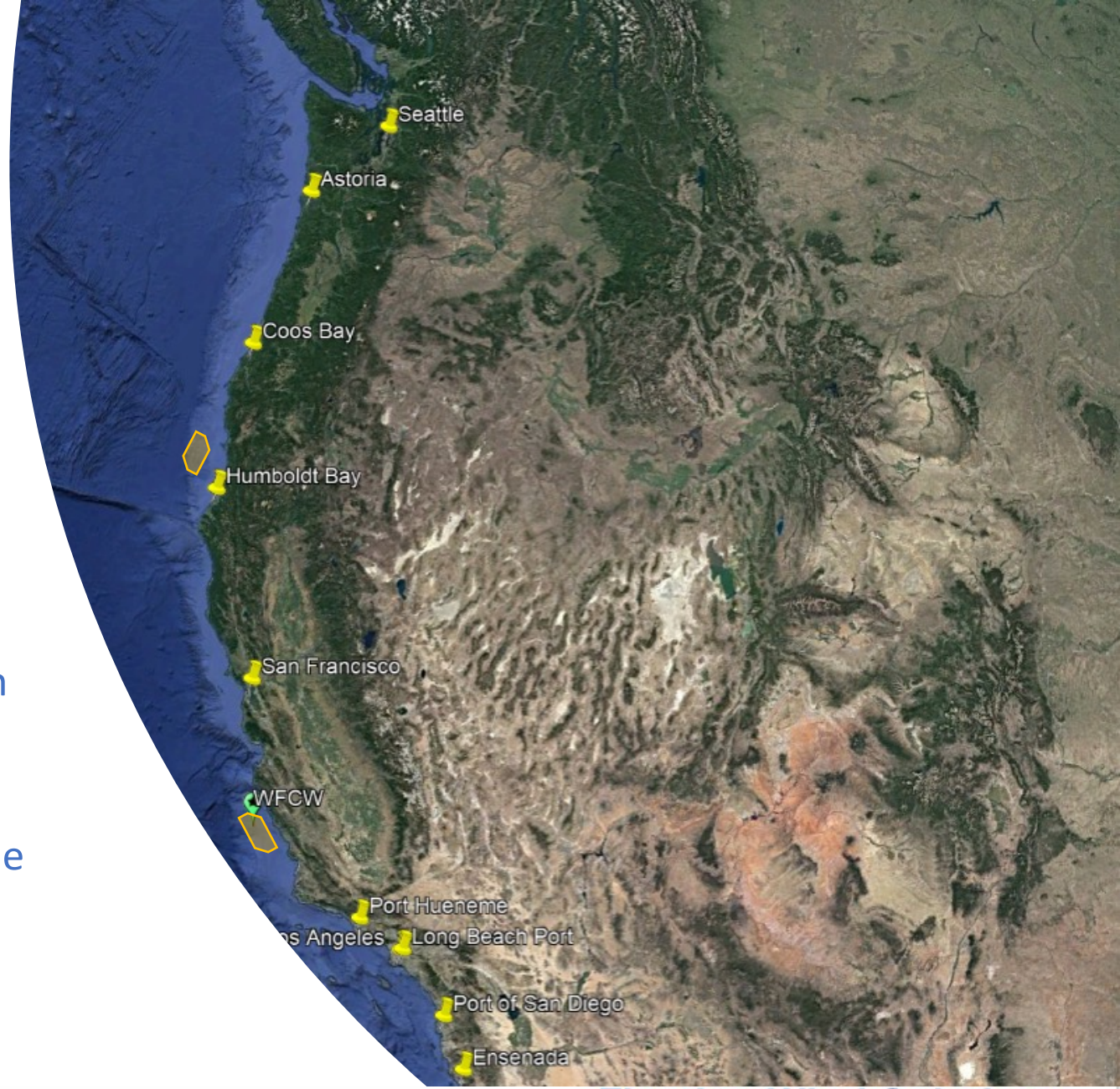
The US West Coast example

- Currently, no port has the sufficient capacity to support all FOW deployment needs
- The ports with the greatest capacities are far from the Lease areas
- Major investments and port infrastructure upgrade are necessary to meet the offshore wind targets



Take-aways

- The available port infrastructure in the US is not sufficient to support all phases of FOW development and significant investments will be required to meet the states goals
- The available fabrication and port infrastructure is a key factor for the selection of floating foundation concept
- Upgrading the infrastructure is essential to harness all the benefits of offshore wind